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RAILROAD FIRE PREVENTION FIELD GUIDE

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March 18, 1980

E. L. Williams
State of Nevada
Division of Forestry
P. O. Box 1507
Elko, Nevada 89801

Dear Mr. Williams:

The California Department of Forestry has for many years had an aggressive railroad fire prevention program. This program is coordinated with our two large cooperative agencies; U. S. Forest Service and Bureau of Land Management.

We have enclosed a copy of the Railroad Fire Prevention Field Guide which is used by protection agencies and the railroads in the maintenance of a statewide fire prevention program. Since we deal with over a dozen different railroad companies, the degree of success differs from company to company as well as by broad geographic areas. Fire protection agencies must keep fire prevention before each company at high levels in order to maintain effectiveness. History has shown that when we relax, fire occurrence goes up, particularly from locomotive carbon emissions.

You will note in Appendix B of the Guide that we have very effective statutes to deal with criminal negligence in causing a fire and to control spark (carbon) emissions. We do not yet have an effective right-of-way vegetation control program although on local levels, when protection agency personnel work closely with railroad rights-of-way personnel, vegetation can be effectively controlled with the result of reducing or eliminating fire ignitions.

In 1978 the Legislature authorized the Director of Forestry to promulgate standards for hazard reduction on railroad rights-of-way when on forest, brush or grass covered lands. We are now in the process of gathering agency, railroad and public comments in the drafting of such regulations. It is anticipated that within the next year such regulations will become law. These regulations will require that railroad rights-of-way be maintained to established standards and the director or agency having primary responsibility for fire protection to order compliance.

We have enclosed a copy of the statute and a draft of the proposed standards which are being used to seek comment. It is expected that the draft standards will be changed considerably. The next step will be to redraft the standards from public comment to be used in public hearings. We believe the hazard reduction standards will provide the tool needed for railroads to voluntarily, at

the risk of criminal violation if they don't, maintain fire safe rights-of-way. Thus the exhaust system and hot metal maintenance standards will not be as critical a risk reduction program.

At the present time we are requesting the railroad companies operating in California all adopt the following standard:

1. Inspect and clean exhaust stacks, sub-stacks, eductor tubes and resnors (mufflers) not less than every 30 days; and
2. Inspect and clean retention traps on spark arresters not less than every seven days.

On a local basis we have evaluated train speed zones (changing speed zones) and have in some cases brought about changes which have reduced fire occurrence specific to the area. We have also worked with the companies to train crews to consider fire risk in the operation of trains; i.e., use of dynamic braking in lieu of air braking where appropriate, reducing speed properly, reporting fires and properly handling equipment breakdowns while equipment is en route.

One of our major carbon emission problems is engines from companies who operate outside California and are not inspected and maintained before entering under foreign power agreements. We think this type of problem can only be solved by hazard reduction and by pressure throughout the United States to maintain engine exhaust systems free of carbon. Fuel additives are not the answer.

If we can be of further assistance please advise.

Sincerely,

M. O. Schori, Chief
Fire Protection

By

Walter Bolster
State Forest Ranger III

lv

Enclosures

cc: Forestry, Regions I, II, IV, V, VI
USFS - Region 5
BLM - Calif. Region

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FOREWORD

This Guide contains standards and practices necessary to minimize forest fires that may be caused by operation and maintenance of railroad transportation systems. These standards and practices are based upon studies and experiences of fire agency and railroad operations personnel as well as on federal regulations and the laws of the State of California. The standards are to be considered as minimums and the various practices are offered as suggestions and examples of what has been tried and found successful in various situations. On–the–ground conditions may indicate the need for effort beyond the minimums and will dictate which practices are most applicable.

It is expected that all personnel who make condition surveys and inspections of railroad rolling stock or rights–of–way or who prescribe hazard reduction work or other fire prevention measures will be thoroughly familiar with the contents of the Guide. It is intended that it be given wide distribution at the field level in both the fire agencies and the railroad companies. Their personnel should use it, refer to it regularly and observe the principles and practices included herein.

This Guide was developed as a cooperative undertaking by the U.S. Forest Service, the Bureau of Land Management, the California Department of Forestry and the railroad companies operating in California. Its purpose is to provide information to the personnel of fire service agencies and railroad companies for minimum uniform application within the areas of their respective jurisdictions and rights–of–way. The Guide is not to be used as a substitute for proper training, but as a handy reference for personnel already familiar with the subject.

This edition of the Guide has been substantially revised not only to reflect changes in laws, regulations, policy and technology but also to improve its usefulness as a field working tool. Except for sample copies retained for historical or reference purposes, all copies of prior editions should be withdrawn from circulation and destroyed.

LEWIS MORAN **Director** **California Department of Forestry**	**ZANE SMITH** **Regional Forester** **U.S. Forest Service**	**ED HASTEY** **State Director** **Bureau of Land Management**

This Railroad Fire Prevention

Field Guide

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For

The United States Forest Service

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In Cooperation

With

Railroad Companies

of California

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INTRODUCTION

The Problem

Railroad operations have been recognized by courts and legislatures since the middle of the nineteenth century as creating an unusual risk of damages by fire. So strong has been this recognition that this field early became one in which the principle of "strict liability" or something akin to it was adopted by the American legal system.

Many states have statutes making railroad companies strictly liable, without negligence, for fires set by their operations or rolling stock, or providing that the fire shall be conclusive as to negligence. Such statutes have been held constitutional as reasonable measures for the protection of property and the adjustment of an inevitable risk. California has a statute, Section 4435, Public Resources Code, which establishes a rebuttable presumption of negligence and makes the act a misdemeanor.

The reasons for such legal concern were obvious during the days of the wood–fired steam locomotive with no screen on its stack. Each step in the evolution of locomotives, to coal–fired steam, to oil–fired steam and to diesel–electric brought prophecies of the end of fire problems caused by railroads. Unfortunately all of these high hopes were doomed for two reasons. First, any combustion process produces carbon in some form and carbon chunks, chips, flakes, etc., are hot enough when ejected to start fires. Second, the early preponderance of fires caused by exhaust obscured the fact that large numbers of fires were caused by other factors inherent in railroad operations, especially air brakes.

That the problem is still with us is proven by the fire statistics of the various wildland fire protection agencies. When looked at on a broad basis (i.e., statewide or regionwide) railroad–caused fires are not unusually numerous or damaging. However, when the perspective is narrowed to those protection units in which railroads are located, some statistics become alarming. For instance, on all state and county protected watershed lands in California, railroads accounted for only 3.5% of all man–caused wildfires during the period 1971–76. During the same period railroads caused 11% of the man–caused fires in one particular Ranger Unit. Similar comparisons appear in Forest Service statistics: 4.3% regionwide, 17% on one particular national forest. These comparisons are not isolated or unique cases; many others could be cited.

On the other hand, the great majority of railroad–caused fires are quite small and do little direct damage. However, a closer inspection reveals that we cannot depend on this observation as it is misleading. At least four railroad–caused fires in the past five years have resulted in total damages and suppression costs in excess of $400,000 each and together caused two deaths and four very serious injuries. Also there are many hidden and indeterminate costs even in little fires. Manpower and equipment are pulled out of position to suppress them quickly before they become big. Meanwhile the firefighting forces are not available to respond to other fires which may then become large as a result.

Thus our admittedly unattainable goal, but the one toward which we should work as hard as we can, is to reduce railroad–caused fires to zero. That it is possible to make significant progress in this direction has been demonstrated in some protection units and on some railroad divisions. One of the primary purposes of this guide is to make their successful methods available for use elsewhere.

The railroad fire problem is basically composed of two parts: risks and hazards. Risks are the sources of ignition. The two most common of these are exhaust carbon particles and brake shoe fragments. Others include hazard reduction burning escapes, grinding, cutting and welding, smoking, discarded fusees, etc. The primary methods of reducing risks are mechanical engineering, inspection, fire prevention education, rules and regulations.

Hazards are the flammable materials that may be ignited by the various risks. In the areas of primary concern in this publication these consist mainly of dry vegetation such as grass, leaves, pine needles, tumble weed, punky logs, dead brush, etc. Other hazards include used ties, discarded poles and crossarms, wooden bridges, snowsheds and trestles, buildings, accumulations of paper or rags, rolling stock, etc. The primary method of reducing hazards is to remove or fireproof them for a sufficient distance from the risks. This may be done by mechanical or physical removal, by burning or by chemical treatment. The proper distance and best method depends on circumstances and will be discussed later.

Railroad Transportation Systems

The primary purpose of railroad transportion systems is to move heavy or bulky freight from one place to another over land. In addition, certain specialized operations such as Amtrak and some excursion trains haul passengers. A very few particularly historic or scenic railroads provide settings for movies and TV programs. In all cases their management's goal is production and profit with safety to cargo, passengers, company personnel and property.

With the exception of Amtrak and a few small municipally or district –owned feeder lines, all railroads are privately owned. They must, therefore, show a profit or be part of an integrated company which shows a profit. Otherwise they will go out of business or be absorbed by some other company.

The great majority of the trackage and rolling stock in California is owned and operated by a very few large companies. The remainder is spread among more than a dozen small companies. Some of these are actually owned by one of the giant corporations but operated under a separate name. Others are owned by lumber companies. Only a few small railroads are truly independent.

The big companies are large bureaucratic organizations with line divisions and staff departments. In many respects they resemble the federal and state agencies with which they deal. The departments with which fire protection agencies have most frequent contact are maintenance–of–way and train operations. Other departments which must be dealt with occasionally include mechanical, claims, traffic, legal, etc. The small companies are much less complex. With them most necessary business can be transacted through one or two persons.

Line–staff relationships vary from company to company and with time. In some companies the staff functions at the division level largely follow those at corporate headquarters. In these cases division engineers (maintenance–of–way), trainmasters, claims agents, etc., all report to the division superintendent. In other companies division superintendents supervise only train operations. In these cases division engineers report directly to the chief engineer, claims agents to the chief claims agent or the legal officer, master mechanics and shop foremen to the chief mechanical officer, etc. Many companies are in organizational transition. Therefore, protection agency personnel should make special effort to acquaint themselves with the organizational pattern of the particular company(s) with which they must deal.

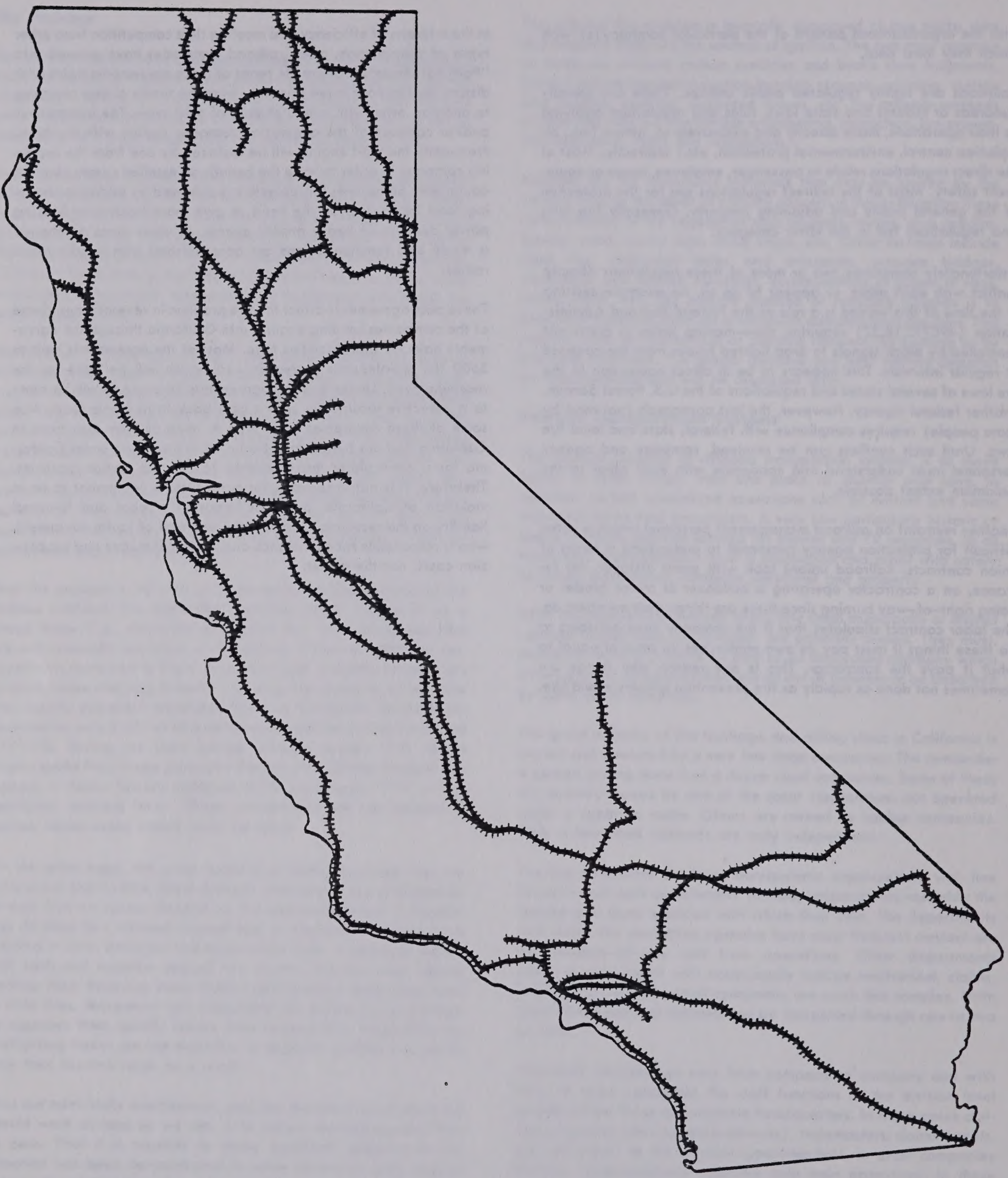
Railroads are tightly regulated public utilities. There are literally hundreds of federal and state laws, rules and regulations applying to their operations, many directly and exclusively so, others (eg., air pollution control, environmental protection, etc.) indirectly. Most of the direct regulations relate to passenger, employee, cargo or equipment safety. Most of the indirect regulations are for the protection of the general public and adjoining property. Generally fire laws and regulations fall in the latter category.

Unfortunately sometimes two or more of these regulations directly conflict with each other, or appear to do so. An example existing at the time of this writing is a rule of the Federal Railroad Administration (49CFR218.37) requiring slow–moving trains in areas not controlled by block signals to drop lighted fusees from the caboose at regular intervals. This appears to be in direct opposition to the fire laws of several states and regulations of the U.S. Forest Service, another federal agency. However, the last paragraph (not read by some people) requires compliance with federal, state and local fire laws. Until such conflicts can be resolved, company and agency personnel must understand and cooperate with each other to the maximum extent possible.

Another restraint on railroad management personnel which is often difficult for protection agency personnel to understand is terms of union contracts. Railroad unions look with great disfavor, for instance, on a contractor operating a bulldozer or motor grader or doing right–of–way burning since these are things their members do. The labor contract stipulates that if the company hires outsiders to do these things it must pay its own employees an amount equal to what it pays the contractor. This is one reason why things are sometimes not done as rapidly as fire prevention officers would like.

In the interests of efficiency and meeting time competition from other types of transportion, many railroad companies have entered into "Pool Agreements." Under the terms of these agreements trains with distant destinations move smoothly from the tracks of one company to another, often with only a change of train crew. The locomotives and/or caboose of the originating company remain with the train. Frequently the lead engine will be replaced by one from the receiving company in order to have the benefit of installed communication equipment. Sometimes this objective is achieved by adding a receiving road locomotive on the head to give more tractive or braking power because of heavy grades ahead. At other times no change is made and communications are accomplished with handie talkie radios.

These pool agreements affect the fire problem in several ways. Some of the companies sending engines into California through the agreements have no shop facilities here. Most of the agreements limit to $500 the maintenance or repair work which will be done by the receiving road. Under existing agreements little can or will be done to a defective locomotive until it gets back to its home road. Also some of these companies have little or none of their own track in California and are therefore not attuned to operating under California laws, particularly those relating to exhaust carbon particles. Therefore, it is not uncommon for out–of–state equipment to be in violation of California law, thus imposing a legal and financial liability on the receiving road. It is the operator of faulty equipment, who is responsible for compliance and/or fire damages and suppression costs, not the owner.



MAJOR RAILROADS of CALIFORNIA

OBJECTIVES AND RESPONSIBILITIES

The basic objective of all parties involved in the publication and distribution of this Guide is to prevent losses of life, property and natural resources and disruption of train operations as a result of fires which may be caused by the operation and maintenance of railroad systems.

It is mutually agreed that the most effective means of attaining the above objective is a cooperative approach. There are many ways in which this cooperation can be implemented. They include, but certainly are not limited to, joint planning meetings, cross–training sessions, joint inspections, notification of critical fire weather, and speeder patrols.

Planning meetings can be of many types. For routine operations the most effective meetings have been found to be annual or semi–annual meetings at the operating unit level, usually a railroad division. All protection agency units should be represented in order to secure uniformity of interpretation and enforcement. At the same time care should be exercised not to overwhelm the company representatives with numbers. Company representatives should include maintenance–of–way, train operations and mechanical personnel at both division and corporate levels. At these meetings both the company's and the protection agencies' work plans and inspection programs are discussed. It is best to limit the agenda for any individual meeting to those topics which can be discussed and resolved in two to three hours.

Annual or biennial meetings of top management level personnel of the agencies and companies to deal with statewide problems and to give guidance to operating level personnel are desirable.

Contact between agency and company personnel should not be restricted to these planning meetings or an occasional training session or inspection. The people who have been most successful at reducing railroad fire occurrence are those who communicate with each other continuously, almost daily. They advise each other of conditions and practices they have observed which may be a problem, whether violations or not, and then suggest alternatives. They also exchange copies of orders, directives, rules and laws whenever new ones are issued or old ones revised.

Both the railroad companies and the fire protection agencies have thorough and efficient training programs for their own employees. However, much remains to be done in conducting such training with mutual assistance between parties. Agency employees, especially inspectors, need an understanding of railroad operations, mechanical equipment, identification and safety hazards which railroad employees are most qualified to teach. Railroad employees need to know first aid fire control methods, how to identify fire hazards and interpretation of laws and regulations — information that protection agency personnel can best provide.

Joint inspections, although sometimes difficult to arrange and not always feasible, provide excellent on–the–job training and promote mutual understanding and trust. For safety reasons, mechanical equipment inspections should always be joint.

Fire agency employees can promote the spirit of cooperation and be of help to the railroads by observing and reporting to the companies broken or damaged equipment or cargo they may observe. They can also often suggest better or more efficient ways of doing things. Most field employees of the railroads are equipped with two–way radio communication which makes it possible for them to be helpful to the protection agencies, especially during critical fire weather, by reporting to the agencies through their dispatchers any fires, fire hazards or risks, or unusual occurrencs that they may observe.

The railroad companies have responsibilities for inspection of railroad rights–of–way and mechanical equipment. Fire protection agencies have responsibilities for assuring that the railroad companies are in compliance with the law. The reasons for and purposes of their inspections differ. Although joint inspections are desirable and helpful, often they are not practical. Also, agency personnel are responsible for many other types of fire prevention activities which preclude their spending as much time on railroad compliance inspections as might be desired.

The railroad companies are responsible for the fire safety of their property and operations and for compliance with the forest and fire laws and have an operational and management responsibility to inspect their equipment and rights–of–way. They must determine what work needs to be done in order to comply with laws and regulations, to prevent fires and to ensure safe and efficient movement of trains. They also need to know, after the work has been assigned, whether or not it has been done and to what standards. They cannot rely on fire agency inspectors for this information.

The protection agencies' inspection responsibilities are primarily regulatory. They should make sample inspections (spot checks) of rights–of–way, rolling stock and other equipment. These spot checks may be of one or two miles to seven or eight miles of right–of–way, of a single locomotive or freight car to a complete train, or of one or more pieces of maintenance–of–way equipment. They will seldom, if ever, encompass the complete right–of–way within a protection jurisdiction. Unless a fire has occurred, locomotives and cars should only be inspected in yards or service areas. Their purpose is to ensure compliance with regulations and to determine the specific causes of problem areas. The protection agency should always notify the company in writing of its findings even when the inspection has been conducted jointly with a company representative, and should also take appropriate enforcement action. However, the company should not treat these notifications as work lists nor should it assume that remarks of "no violations observed" contained in agency reports or the lack of inspection of some areas or equipment mean that there are in fact no violations. Agency inspections will also be made for investigation of the causes of fires that have already occurred.

Correction of violations and the maintenance of effective risk and hazard reduction measures are the responsibilities of the railroad companies. Company employees of any level or specialty should never pass by an obvious violation or other problem merely because it is not on their assigned work list. Fire agency personnel must never ignore an observed violation, but should report broken or damaged equipment or an ineffective or unsafe fire prevention practice to the company in order that it may be corrected promptly.

In the past many companies have considered the costs of fire prevention work and the damages and suppression costs of fires as non–productive costs somewhat akin to taxes and insurance premiums. At least one large company has, in the past four or five years, reassessed this position and now treats fire prevention as a productive, or at least a cost avoidance, activity. This reorientation has resulted in a change of priorities in budgeting dollars, time and effort and in better relations with the fire protection agencies.

Fire protection agencies are charged with the responsibility of enforcing certain fire prevention laws. The California Department of Forestry, U.S. Forest Service, Bureau of Land Management and other

wildland protection agencies may initiate administrative, civil, criminal or injunctive actions to secure compliance with laws and ordinances. It is the policy of all these agencies not to take indiscriminate and arbitrary law enforcement action. However, when violations are present, and can be supported by facts, failure to take action represents a dereliction of duty. Criminal or other legal action is probable.

EXHAUST SYSTEMS

Exhaust sparks, usually carbon chunks or flakes, have long been the single greatest cause of railroad right–of–way fires, although in some areas this may not be true. One recent study indicated that, at least in that area, brake shoes caused 55% of railroad fires compared to 35% from exhaust. However 35% is still a very large proportion which deserves concerted prevention action.

In order to prevent fires caused by exhaust sparks, personnel need a basic understanding of the several types of exhaust systems and their components. Almost all operating locomotives are diesel–electric; therefore the bulk of this chapter will be devoted to them. A brief section will discuss steam locomotive exhaust systems. Full electric locomotives supplied with external power sources have no exhaust systems and will not be discussed.

In a diesel–electric locomotive the diesel engine drives an electric generator or alternator. Current supplied by the generator provides the power to turn electric traction motors which are mounted on the trucks of the locomotive. These traction motors then turn the wheels of the locomotive through a set of reduction gears.

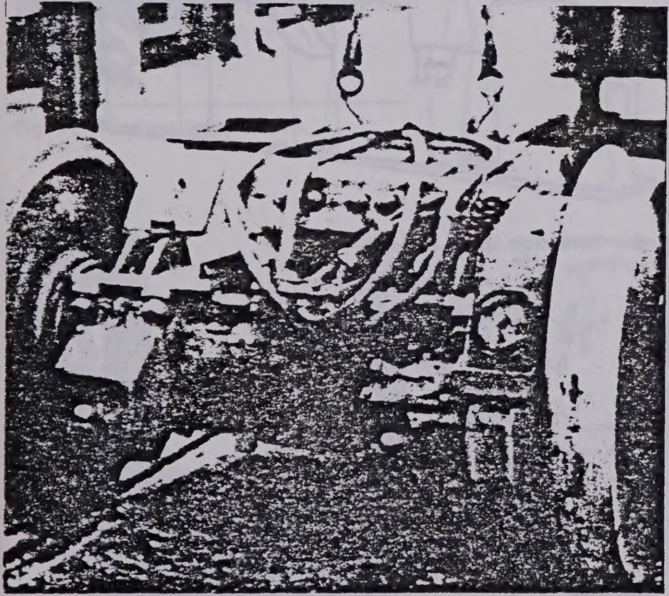


Fig. 1. Traction motor and reduction gear box.

Smoke by itself is not necessarily an indication that the locomotive is emitting carbon sparks. Some types of locomotives naturally produce more smoke than others, especially at low speed or under heavy load. Smoky exhaust, especially brown or thick black smoke, from a locomotive which is normally not a smoker is usually an indication of some mechanical problem, eg., faulty fuel injector, broken intake or exhaust valve, cracked ring or piston, etc. It may, as a result, also be emitting sparks but they are often hidden in the smoke. It also may not be emitting sparks.

In order to avoid crankcase explosions it is necessary to evacuate the fumes from the crankcases of diesel engines. To get maximum horsepower from a given size of diesel engine it is necessary to supply air to the cylinders at greater than atmospheric pressure (supercharged). The manner in which these two operations are accomplished provides one common method of designating broad types of engines and has a marked effect on the ways in which exhaust sparks are created and are prevented from escaping to cause fires. The common terms for these two types of diesel engines are "normally aspirated" and "turbocharged."

NORMALLY ASPIRATED DIESEL ENGINES

On this type of diesel engine the intake air is supercharged by means of a gear–driven blower. The most common of these is the Roots Blower.

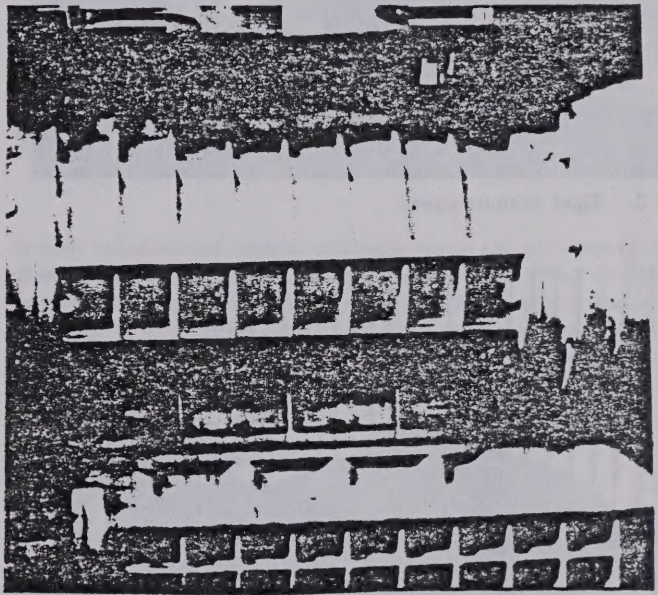


Fig. 2. Roots Blower.

Crankcase fumes are withdrawn ("aspirated") by a tube connecting the crankcase through an oil separator with the intake side of the blower where a slight vacuum exists. Thus the crankcase fumes pass through the cylinders and if any oil is present in them it is burned along with the fuel oil.

The exhaust carbon created in this configuration is generally hard, non–porous and very hot. It cools rapidly in open air but can easily start fires in dry vegetation or other flammable material if it is large enough to maintain a temperature at or above their ignition level for any significant time. Therefore it is important to either trap the particles or break them up into pieces too small to cause a fire problem. Two basic methods have been employed for doing this: screens and spark arresters.

Screens are the oldest and simplest method of preventing the escape of carbon particles. Screens are usually attached to the top of the exhaust stack. They are not, however, very effective and can cause other problems. If the holes are small enough to stop all dangerous particles they cause excessive back pressure. Screens also tend to clog up and burn out, thus requiring frequent cleaning and replacement. They are no longer used on road engines; their use is now confined to smaller and older yard and switch engines.

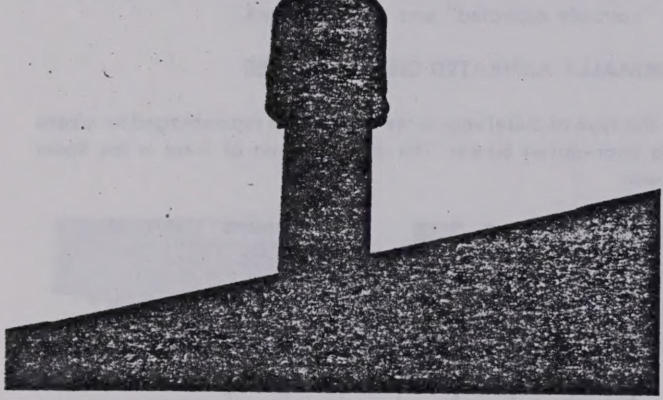


Fig. 3. Rigid exhaust screen.

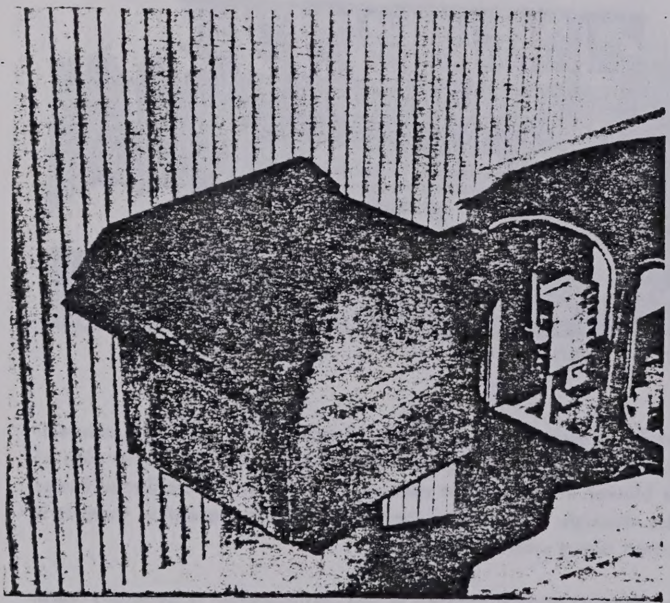


Fig. 4. Self–cleaning exhaust screen.

Modern locomotive spark arresters are of the vortex type wherein the exhaust gasses are directed tangentially into a cylindrical chamber at various points along the chamber but expelled at only one point, producing a spiral motion of the gasses in the chamber. There are two variations of this system: the attrition arrester and the retention arrester.

The idea of the attrition spark arrester is, by means of a series of baffles and vanes, to chop up the carbon particles into such small pieces (dust) that they cannot start fires. While moderately successful on small gasoline or LPG fueled engines, this type of spark arrester cannot usually meet legal standards on large diesel engines, at least not in California. Therefore it is not likely to be found on locomotives operating regularly in California but may be found on engines entering the state under pooled power agreements.

The retention spark arrester depends upon centrifugal force to throw the carbon particles, which are much heavier than the gasses carrying them, against the outer walls of the chamber. From here they are channelled to externally mounted traps which can be emptied by removing a cap on the bottom.

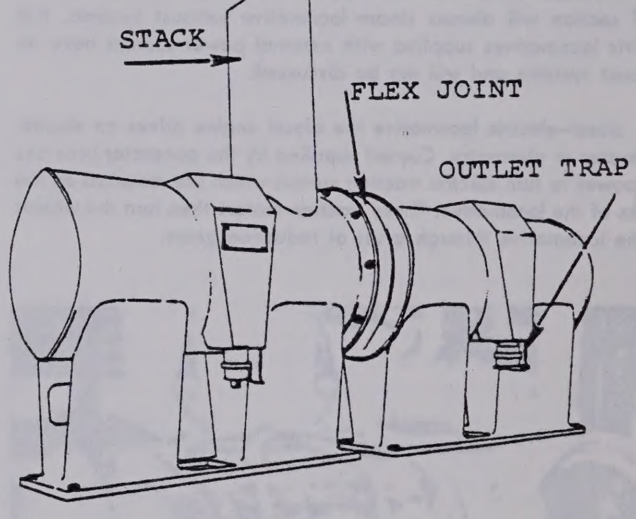


Fig. 5. Retention spark arrester.

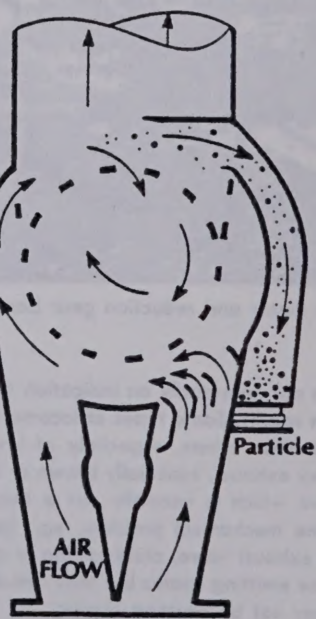


Fig. 6. Cross section of retention spark arrester.

It has been found from experience that, unless the engine is in perfect condition, these traps tend to fill up fairly quickly. This destroys the arresting capability of the system and sparks start going out of the stack. Therefore, it is recommended that the traps be emptied no less often than every seven (7) days. Some companies do this every five days.

In California both attrition and retention spark arresters rated and approved by the U.S. Forest Service are legal unless it can be proved that particles larger than 0.0232 inch in diameter will escape the exhaust system.

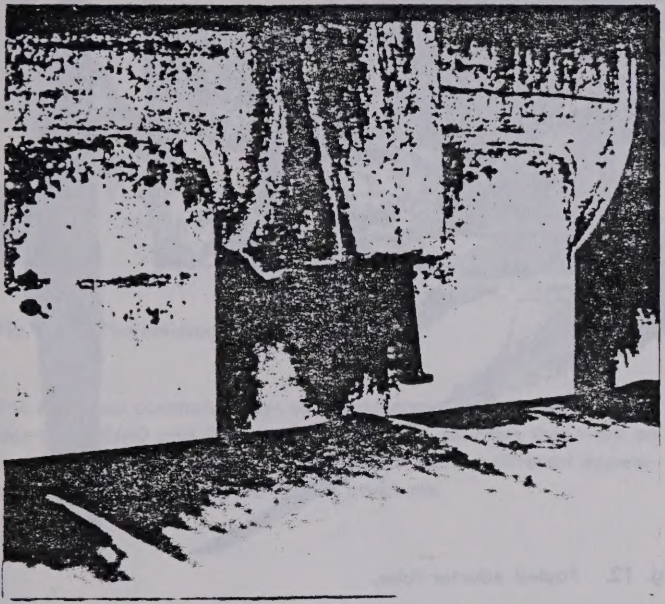


Fig. 7. Carbon trap, closed.

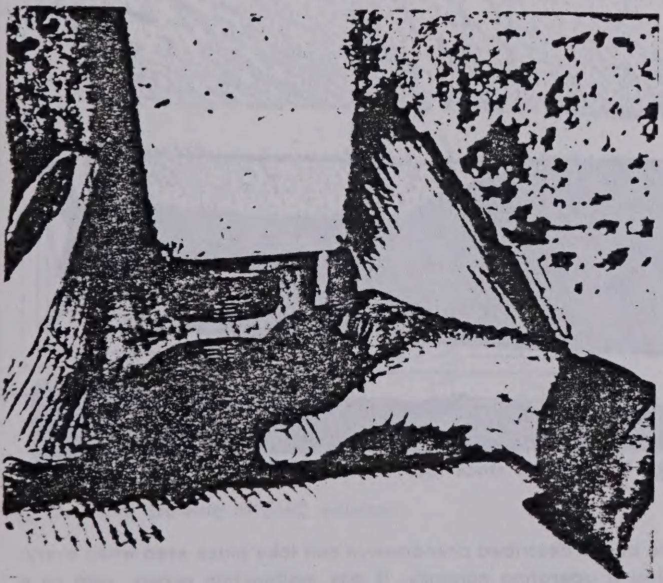


Fig. 8. Carbon trap, open.

TURBOCHARGED DIESEL ENGINES

On this type of engine supercharging is achieved by a blower which is driven by the exhaust gasses passing by impeller vanes mounted on a common shaft with the blower vanes. There are several makes and models of these but they all operate on the same principle.

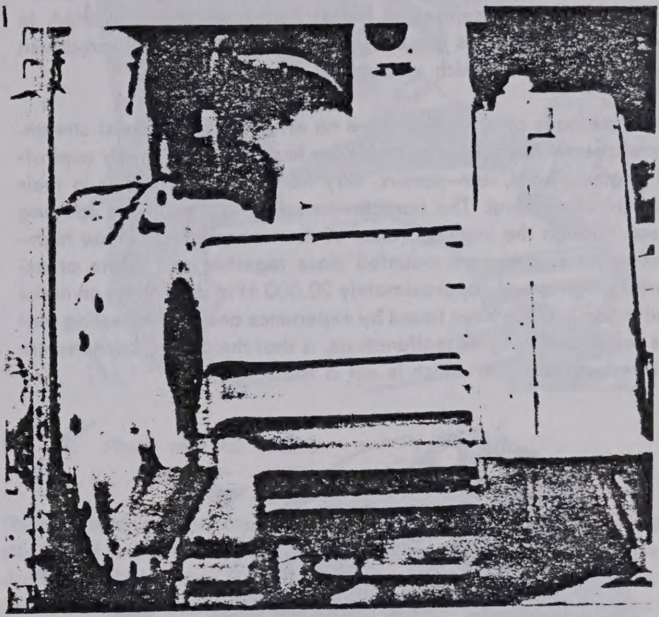


Fig. 9. Turbocharger, EMD engine.

In most turbocharged engines crankcase fumes are not removed by direct suction as in the normally aspirated engines. Instead a venturi principle is used. This is commonly called an eductor. It is similar in operation to a jet water pump or ejector used by wildland firemen to lift water from levels below the drafting capacity of their pumps.

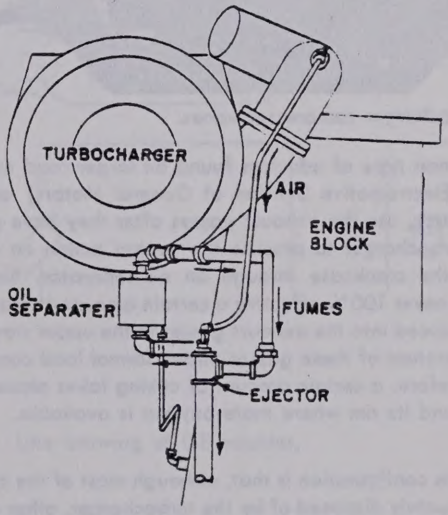


Fig. 10. Baldwin crankcase breather.

Several configurations of venturis exist. One of the older ones, used on Baldwin locomotives, uses a small portion of the supercharged intake air from the cylinder side of the turbocharger to draw fumes from the crankcase through an oil separator and expel them to the atmosphere between the wheels.

ALCO (American Locomotive Company) engines, although turbocharged, are an exception to the venturi crankcase aspiration. In them crankcase fumes are drawn off by an electric motor–driven centrifugal blower which exhausts to the atmosphere.

These methods of aspiration have no effect on the exhaust stream. Consequently the carbon particles are like those in normally aspirated engines: hard, non–porous, very hot. The difference is in their manner of disposal. The particles travel, with the gasses carrying them, through the impeller vanes of the turbocharger. These high–carbon steel vanes are mounted close together and rotate at extremely high speed (approximately 20,000 RPM depending on make and model). It has been found by experience and limited testing that the result, assuming no malfunctions, is that the carbon particles are chewed up into dust which is not a fire risk.

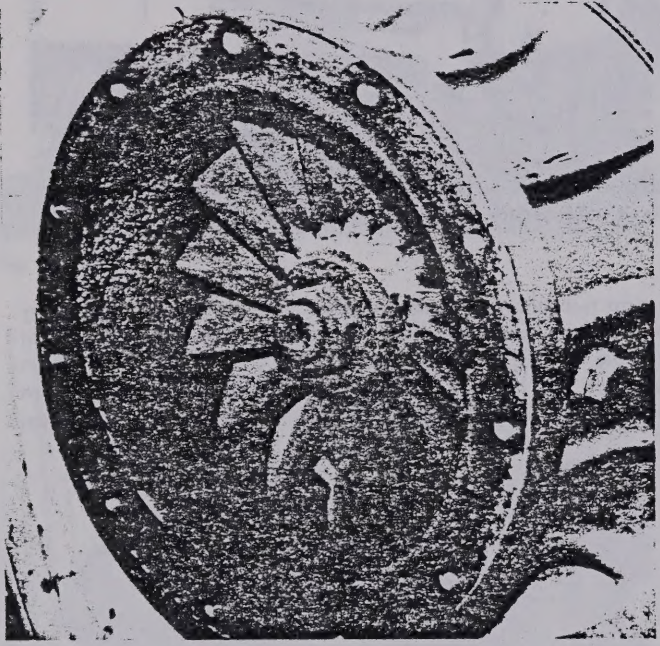


Fig. 11. Turbocharger compressor vanes.

The more common type of eductors found on larger road engines, mostly EMD (Electromotive Division of General Motors) and GE (General Electric), use the exhaust gasses after they have passed through the turbocharger to provide the venturi action on a tube connected to the crankcase through an oil separator. Since oil separators are never 100% effective a certain amount of crankcase oil is thus introduced into the exhaust gasses in the upper stack. The average temperature of these gasses under normal load conditions is 1100°F. Therefore, a certain amount of coking takes place in the stack and around its rim where more oxygen is available.

The result of this configuration is that, although most of the cylinder carbon is adequately disposed of by the turbocharger, other carbon is formed. This carbon is different than cylinder carbon and in many ways more dangerous from a fire standpoint. It is soft and porous. The pores are not void but full of oil. Although this carbon may not be as hot initially as cylinder carbon, it is hot enough to ignite the contained oil as soon as sufficient oxygen is present. Such particles have been observed coming out of the stack apparently cold and bursting into flame within a fraction of a second after alighting on flammable materials. This phenomenon has been verified by research at the U.S. Forest Service Fire Laboratory in Riverside, California.

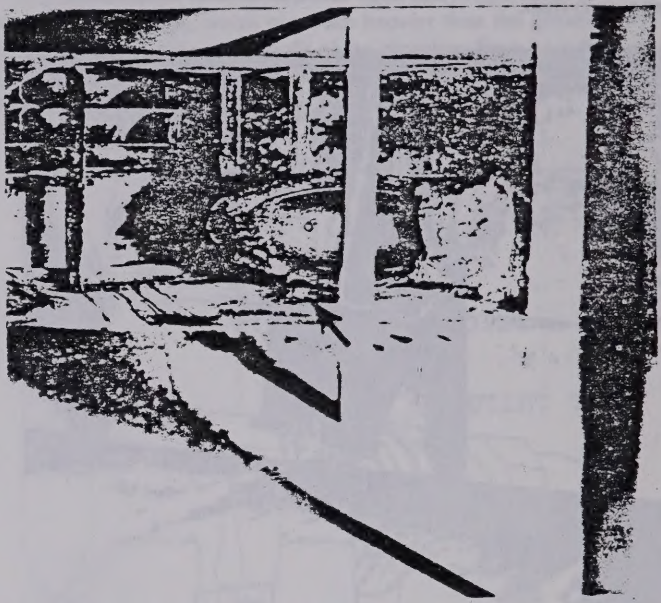


Fig. 12. Fouled eductor tube.

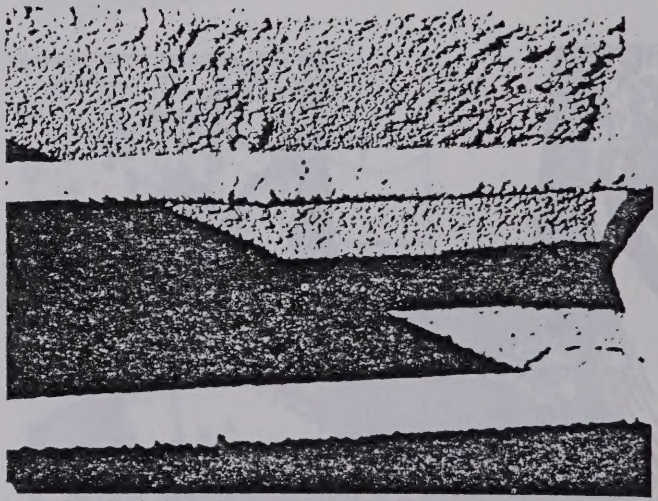


Fig. 13. Fouled stack top.

The above described phenomenon can take place even when everything is operating normally. If any malfunction occurs, such as a clogged oil separator or a blown shaft oil seal on the impeller side of the turbocharger, excessive amounts of oil will be discharged into the hot exhaust gasses in the stack and the carbon build–up situation will be aggravated.

Fig. 14. Photomicrograph of soft carbon.

The two most common makes of turbocharged locomotives in use at this time (EMD and GE) have a crankcase eductors that work on the same principle. However, they present quite a different appearance and different fire prevention problems.

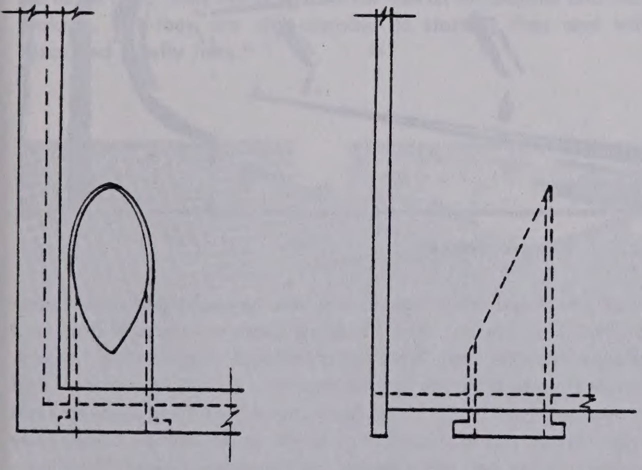


Fig. 15. Line drawing of EMD eductor.

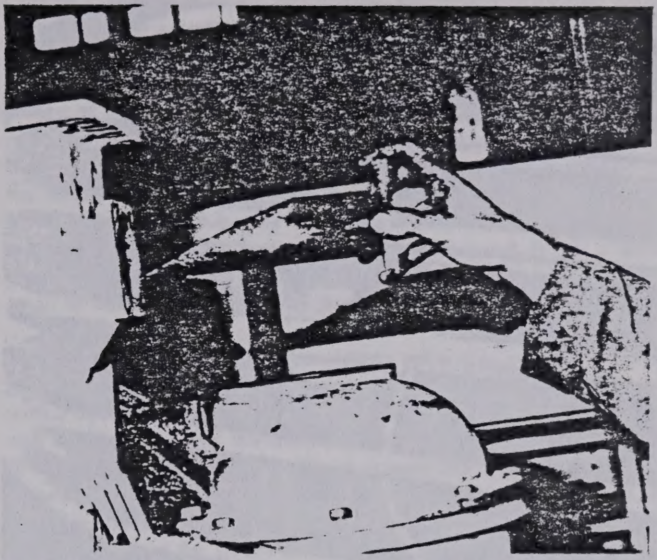


Fig. 16. Photo of EMD eductor.

The standard EMD eductor tube is removable from the outside of the stack, and is thus easily cleaned of carbon or replaced. Its protective shroud is welded into the side of the stack. The shroud commonly gets coked up the same as the tube itself, but it is much more difficult to clean. Several companies have developed their own special tools for this purpose.

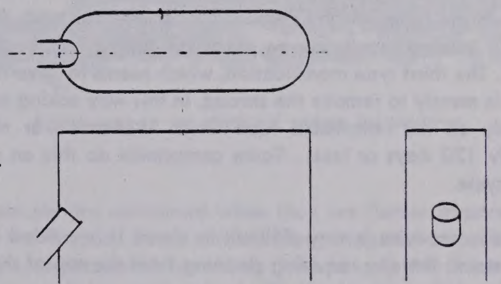


Fig. 17. Line drawing of GE eductor.

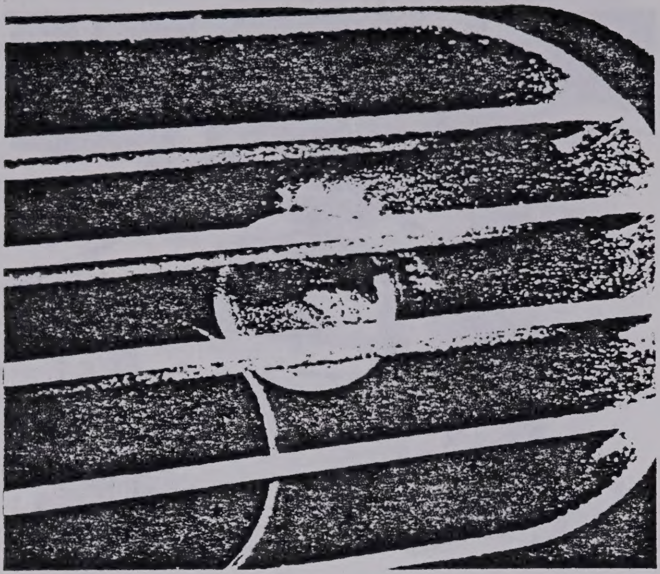


Fig. 18. Photo of GE eductor.

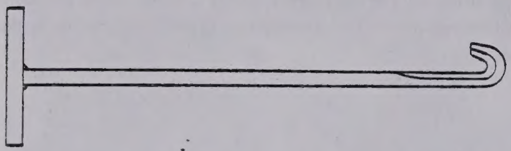


Fig. 19. SP shroud cleaning tool.

Three different methods of modifying this system are undergoing field testing. One is to make both the eductor tube and the shroud removable for cleaning. The second is to replace the stack venturi with an air ejector (pressurized air from the air box). In this modification both the tube and the shroud are cut off flush with the inner stack wall leaving practically no place for coking to take place in the stack. The third type modification, which seems to have the most promise, is merely to remove the shroud. In this way coking can take place only on the removable tube which is cleaned or replaced frequently (30 days or less). Some companies do this on a 13 to 15 day cycle.

The GE eductor tube is very difficult to clean. It is welded into the exhaust stack, thereby requiring cleaning from the top of the stack. The angle of the tube, the baffle in the tube and the presence of gratings over the top of the stack combine to make effective access very difficult. Again, various companies have developed special tools for this operation.

Fig. 20. WP eductor cleaning tool.

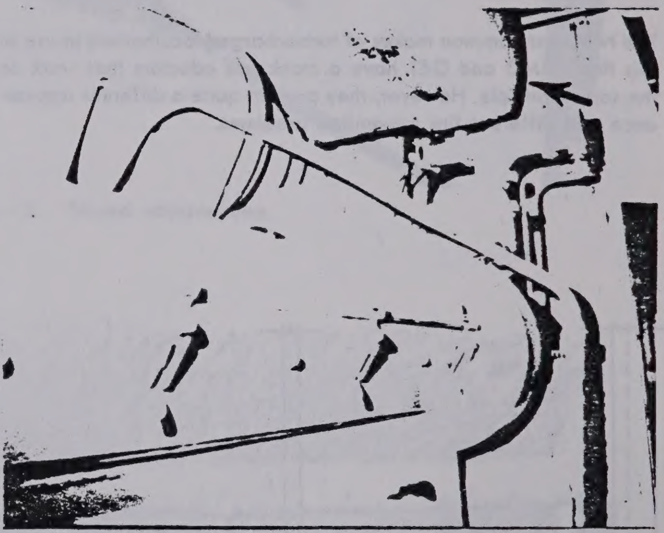


Fig. 21. Amtrak silencer.

Amtrak passenger train locomotives are turbocharged diesel electrics. Thus, they present similar exhaust spark problems as discussed above except that they have an additional complicating feature. Because of noise pollution regulations they are required to be fitted with silencers (mufflers). It has been found that these silencers tend to trap carbon particles until they build up an accumulation. They later break loose and are expelled on the right-of-way. The silencers also make it impossible to inspect or clean the eductor tube from the top. The tube must be removed for inspection and cleaning.

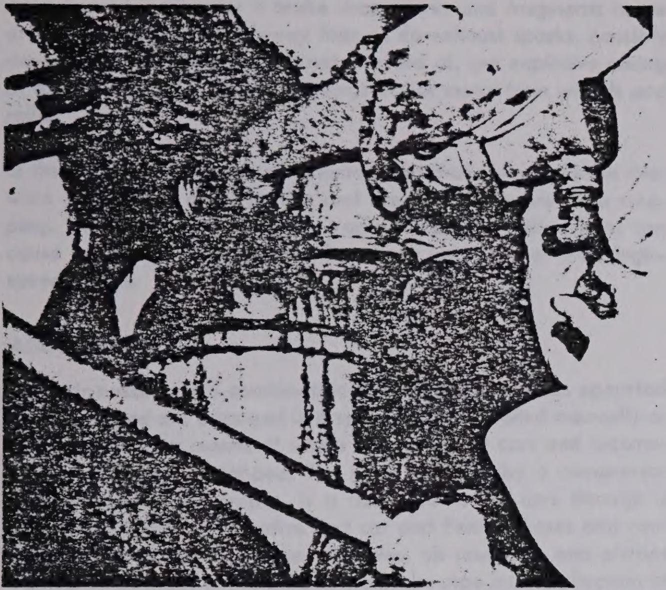


Fig. 22. Amtrak eductor tube removal.

Some of the most recent models of EMD freight engines are equipped with exhaust silencers. They can be expected to present the same carbon build–up and inspection problems as do Amtrak locomotives.

STEAM LOCOMOTIVES

Steam locomotives, fired by wood or coal, were the original railroad fire setters. Fortunately, for fire protection agencies there are very few steam locomotives left. All these were either built for or converted to oil fuel. Their use is usually for tourist attractions and movie–making, but they are still capable of starting fires and will be discussed briefly here.

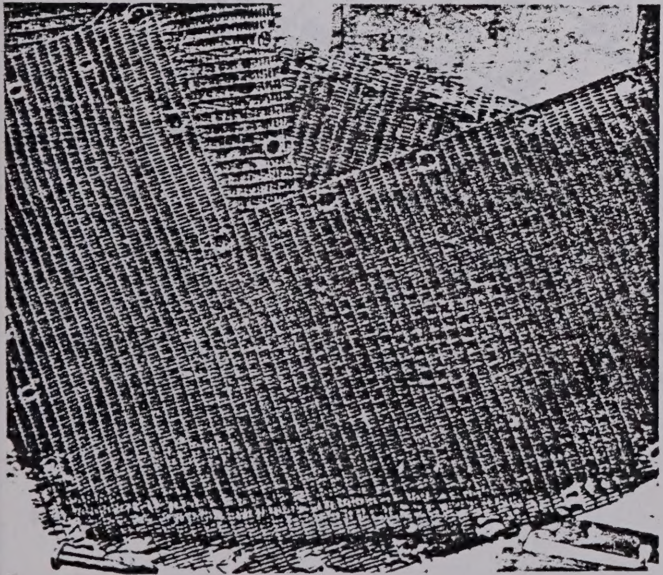


Fig. 23. Internal spark screens, steam locomotive, removed for cleaning.

Carbon is formed in steam locomotives primarily in the boiler tubes and to a lesser extent any place where the exhaust gasses meet an obstruction or change direction. Carbon on the walls of the boiler tubes is not only a potential fire starter but also reduces the efficiency of the boiler by acting as a heat insulator. It is, therefore, important for the operating company to prevent any more than a slight build–up of carbon there. This is done by frequent sanding of the tubes. By this process sand is introduced into the firebox and carried through the tubes by the strong draft. In the process it scours the sides of the tubes of carbon leaving bare metal. If this is done often enough, eg., once a day, the carbon particles removed are too small to cause a right–of–way problem.

To make doubly sure that carbon sparks will not be emitted from the top of the stack, most railroad companies fit their steam locomotives with a double set of screens. One set is internal between the exhaust end of the tubes and the smoke stack. The other set of screens is fitted to the top of the stack. These screens are subject to the same drawbacks as exhaust screens on diesel engines: clogging, back pressure, burning out, etc., but they are the only practical spark arresting system for steam locomotives.

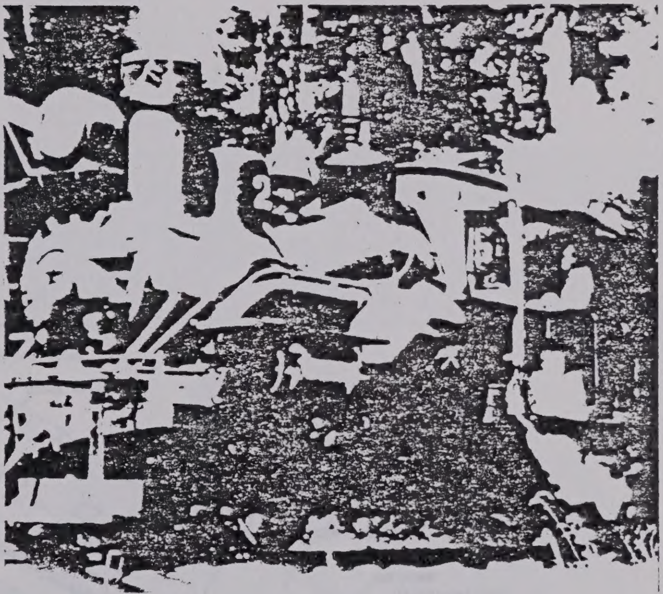


Fig. 24. Spark screen on stack of steam locomotive.

Some people are concerned when they see flames apparently outside of the firebox. There is seldom anything to worry about here. Ordinarily the indraft is so strong that not only the flame but anything else that is loose is immediately drawn inside the firebox. About the only situation in which the firebox presents a wildfire problem is if the locomotive is parked where the roadbed has not been cleaned of standing dry grass.

BRAKE SYSTEMS

As indicated in Chapter II brake shoe sparks and fragments cause at least as many right–of–way fires as do exhaust sparks, possibly more. Much less common, but not unheard of, are explosive arcing of dynamic brake grids and shavings of hot metal from wheels and rails.

In the past it has often been assumed that brake shoe–caused fires were confined to down grades and areas where trains were stopping. This is not necessarily so. Various types of malfunctions can cause hot brake shoe chips to fly off on upgrades or level high–speed tracks.

A fundamental understanding of train brake systems and how they operate is necessary if we are to be effective in preventing fires from this cause. All railroad rolling stock is equipped with air brakes. Most modern road locomotives are also equipped with dynamic brakes. These two braking systems are often used together and one affects the other in various ways. Therefore, this chapter is divided into three sections, one for each system alone and one for combination use.

AIR BRAKES

Train air brakes are a combination of mechanical devices operated by compressed air, arranged in a system and controlled manually or pneumatically, by means of which the motion of cars and locomotives is retarded or stopped. The air is supplied by a compressor mounted on the locomotive. It is delivered to the cars through a brake pipe in each locomotive and car and flexible hoses and couplings between them. A series of valves, air reservoirs and pistons transforms changes of pressure in the brake pipe into application or release of pressure by the brake shoes against the wheels. These changes in brake pipe pressure are normally initiated deliberately by the locomotive engineer but may be initiated from other positions or by malfunctions.

Through the automatic brake valve located on his control stand, the locomotive engineer supplies air to the brake pipe in his locomotives and cars. This air charges the auxiliary and emergency air reservoirs of the car brake equipment and the auxiliary reservoirs on the locomotives. Various settings of the automatic brake valve handle then vary the brake pipe pressure to cause the automatic train brakes to apply or release at service or emergency rates. A separate handle on the brake valve allows the engineer to control the air brakes on the locomotive independently of those on the rest of the train if he so wishes.

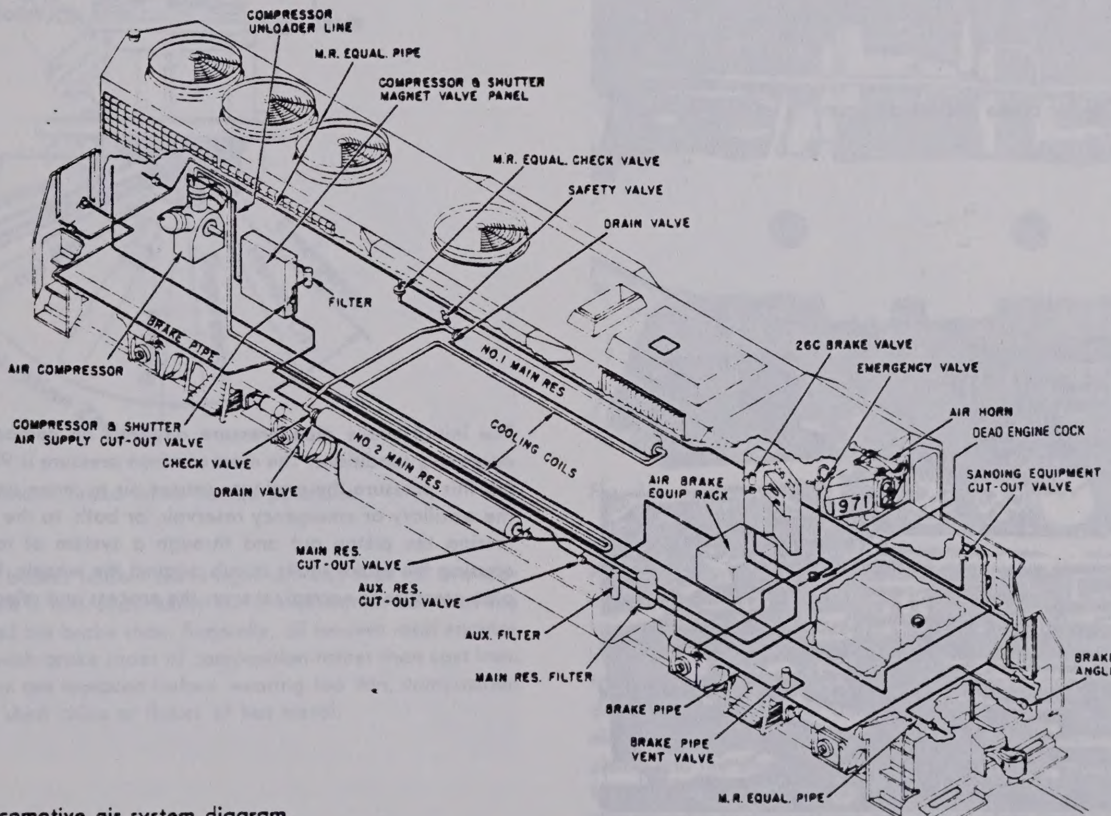

COMPRESSOR UNLOADER LINE
M.R. EQUAL. PIPE
COMPRESSOR & SHUTTER MAGNET VALVE PANEL
M.R. EQUAL. CHECK VALVE
SAFETY VALVE
DRAIN VALVE
FILTER
BRAKE PIPE
AIR COMPRESSOR
NO.1 MAIN RES
COOLING COILS
NO 2 MAIN RES.
COMPRESSOR & SHUTTER AIR SUPPLY CUT-OUT VALVE
CHECK VALVE
DRAIN VALVE
MAIN RES. CUT-OUT VALVE
AUX. RES. CUT-OUT VALVE
AUX. FILTER
MAIN RES. FILTER
26C BRAKE VALVE
EMERGENCY VALVE
AIR HORN
DEAD ENGINE COCK
SANDING EQUIPMENT CUT-OUT VALVE
AIR BRAKE EQUIP RACK
1971
BRAKE PIPE ANGLE COCK
BRAKE PIPE
BRAKE PIPE VENT VALVE
M.R. EQUAL. PIPE

Fig. 25. Locomotive air system diagram.

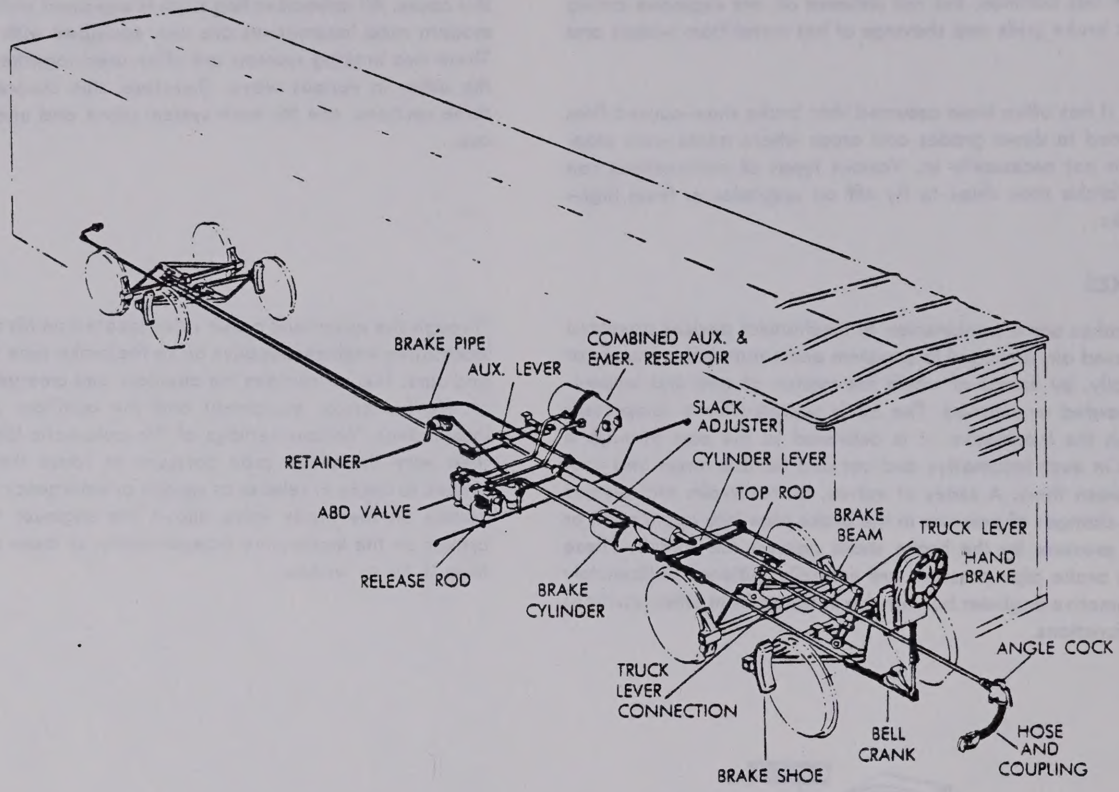

BRAKE PIPE
AUX. LEVER
COMBINED AUX. & EMER. RESERVOIR
SLACK ADJUSTER
RETAINER
CYLINDER LEVER
TOP ROD
ABD VALVE
BRAKE BEAM
TRUCK LEVER
HAND BRAKE
RELEASE ROD
BRAKE CYLINDER
ANGLE COCK
TRUCK LEVER CONNECTION
BELL CRANK
HOSE AND COUPLING
BRAKE SHOE

Fig. 26. Car air brake system diagram.

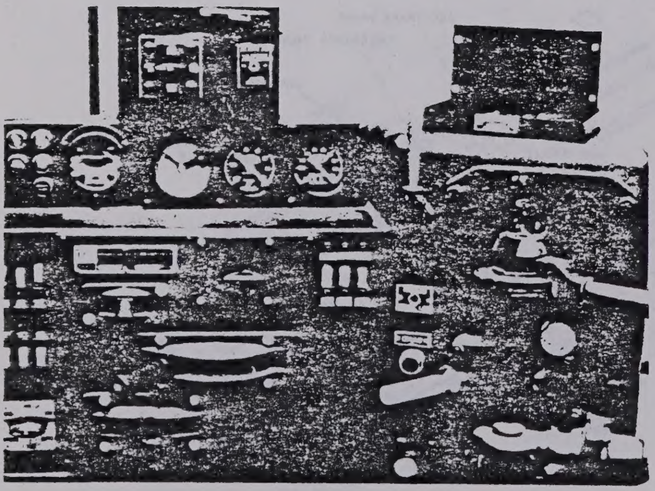


Fig. 27. Engineer's control stand, brake valves on left, throttle and dynamic brake controls on right.

The initial brake pipe pressure depends on company policy and operating conditions. The most common pressure is 90 psi. By reducing this pressure the engineer causes air to move on each car from the auxiliary or emergency reservoir, or both, to the brake cylinder, forcing the piston out and through a system of rods and levers, causing the brake shoes to rub against the wheels. Restoring brake pipe pressure to normal reverses the process and releases the brakes.

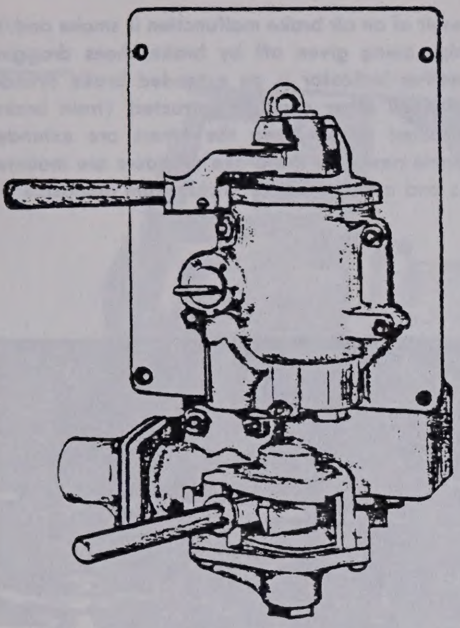


Fig. 28. Automatic (upper) and independent (lower) brake valves.

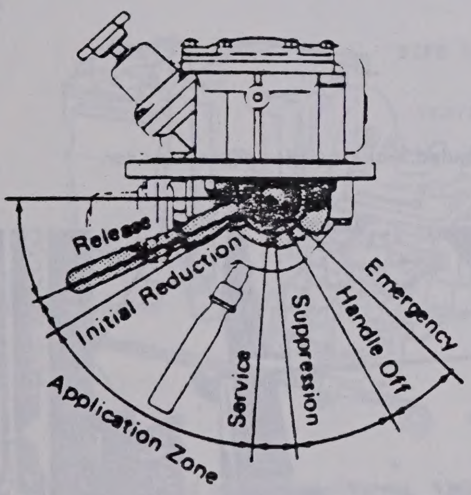

Release
Initial Reduction
Service
Suppression
Handle Off
Emergency
Application Zone

Fig. 29. Automatic brake valve handle positions.

Locomotive air brakes seldom cause right–of–way fires for two reasons. First, there is less opportunity for a malfunction between the brake valve and the brake shoe. Secondly, all modern road engines are equipped with brake shoes of composition rather than cast iron. So long as they are replaced before wearing too thin, composition shoes will not shed chips or flakes of hot metal.

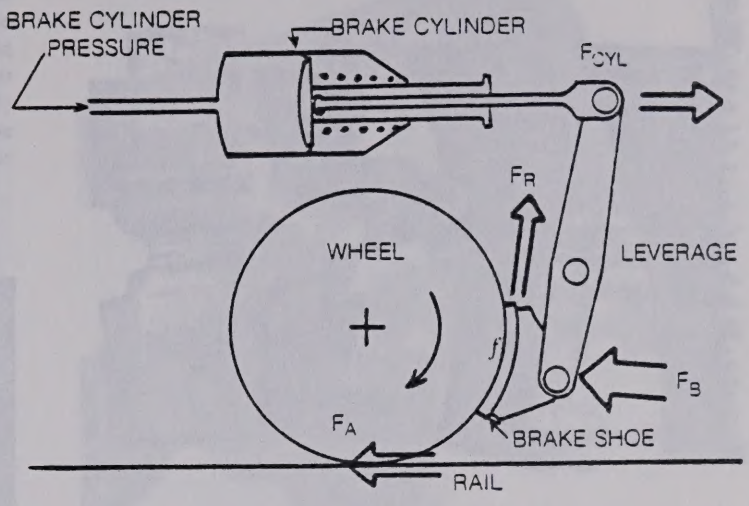

BRAKE CYLINDER PRESSURE
BRAKE CYLINDER
F_{CYL}
F_R
WHEEL
LEVERAGE
f
F_B
F_A
BRAKE SHOE
RAIL

Fig. 30. Air brake linkage diagram.

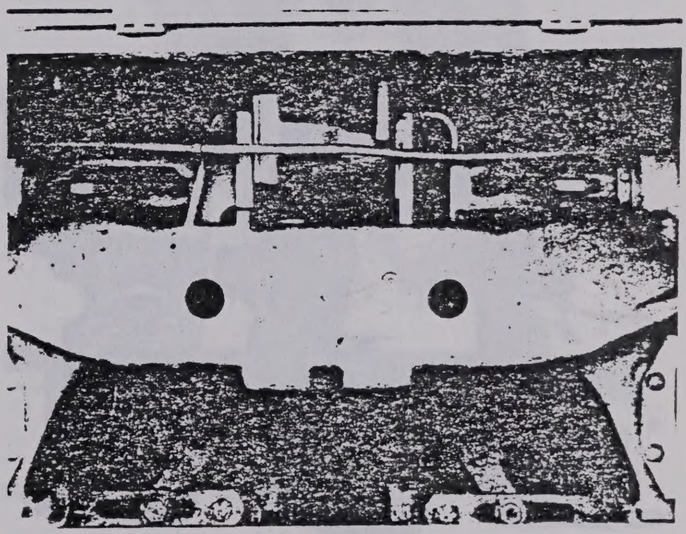


Fig. 31. Locomotive air brakes.

Passenger cars and new freight cars (those built since 1970) also use composition brake shoes. All older freight cars, however, still use standard or high phosphorous cast iron brake shoes. These are still in the majority and cannot be expected to go entirely out of service for many years. Since cast iron and composition shoes have such different coefficients of friction it is not practical to try to convert older cars to composition shoes. The rigging between the brake piston and the shoes cannot be adjusted enough and would all have to be replaced. One of the worst things that can happen from a fire standpoint is to mix cast iron and composition shoes on the same car. It causes extremely rapid wear of the composition shoe, and will very soon wear through to the metal brake head and cause sparking. This practice is against company, AAR and FRA rules, but occasionally happens by mistake.

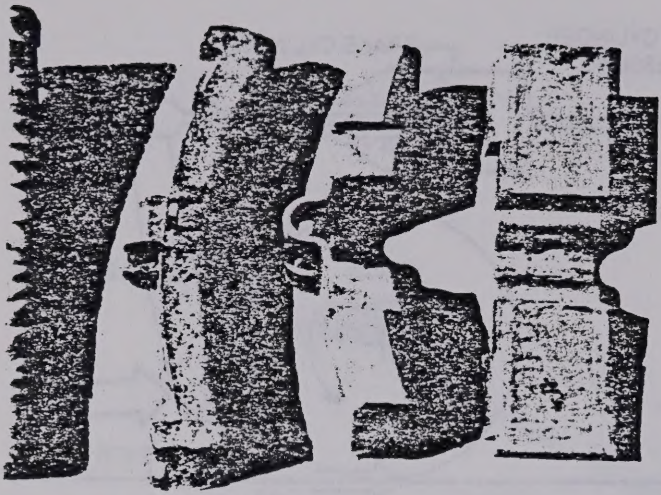


Fig. 32. New brake shoes, cast iron on left, composition center and right.

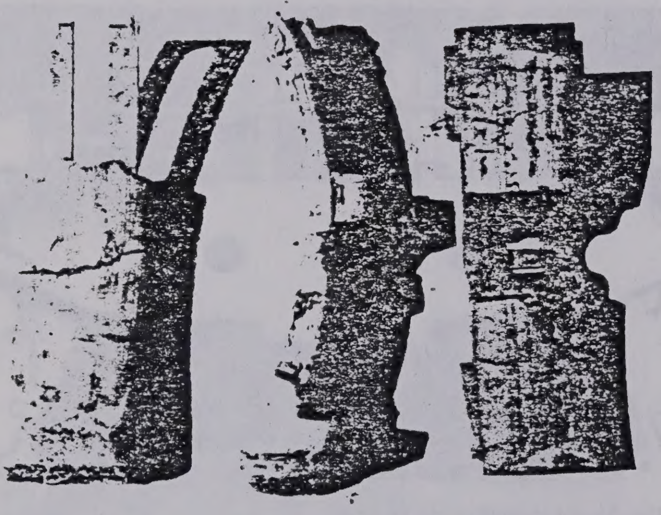


Fig. 33. Worn brake shoes, cast iron left and center, composition right.

Malfunctions can happen at many different places and from various causes, most of which would be invisible or unrecognizable to a fire agency inspector. On the other hand, the results or symptoms are usually visible and should be recognized by the inspector. He should also know what must be done to correct the problem or to isolate the offending car from the train brake system. He should never attempt to take such action personally, but should merely satisfy himself that it has been done by company employees.

The most obvious result of an air brake malfunction is smoke and/or hot sparks and chips being given off by brake shoes dragging against wheels. Another indicator is an extended brake cylinder piston when those on all other cars are retracted (train brakes released) or a retracted piston when the others are extended (brakes set). On some new cars the brake cylinders are mounted on the wheel trucks and are not readily visible from alongside the car.

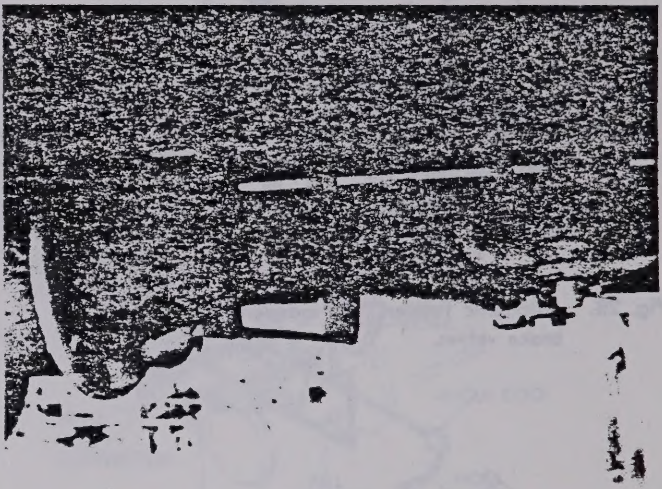


Fig. 34. Extended brake cylinder piston, box car.

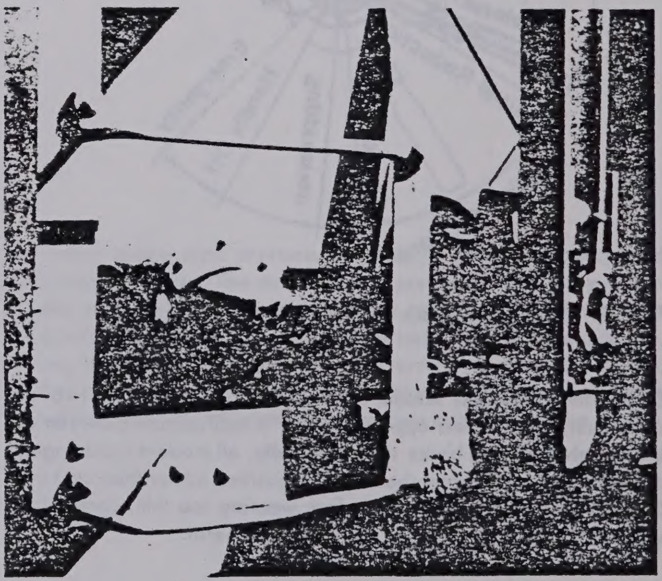


Fig. 35. Retracted brake cylinder piston, hopper car.

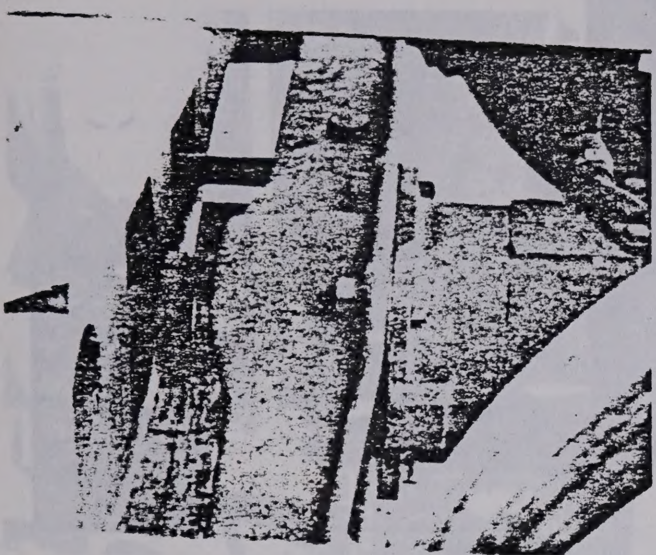


Fig. 36. Truck–mounted brake cylinder.

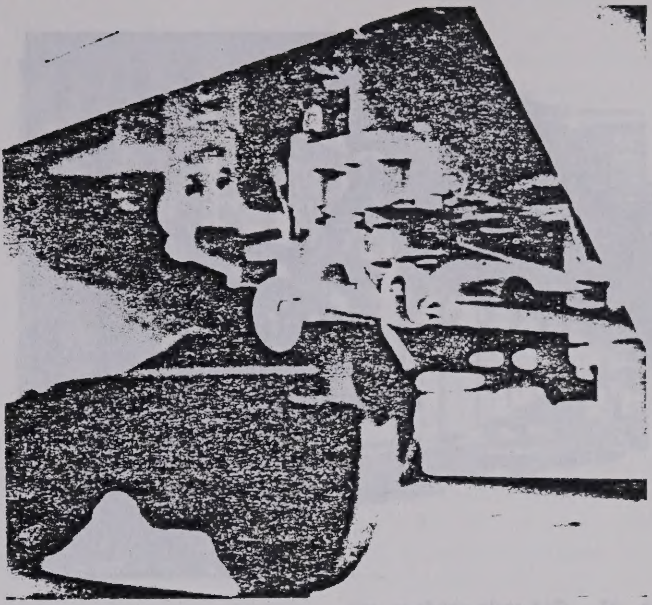


Fig. 38. ABD valve and release rod photo.

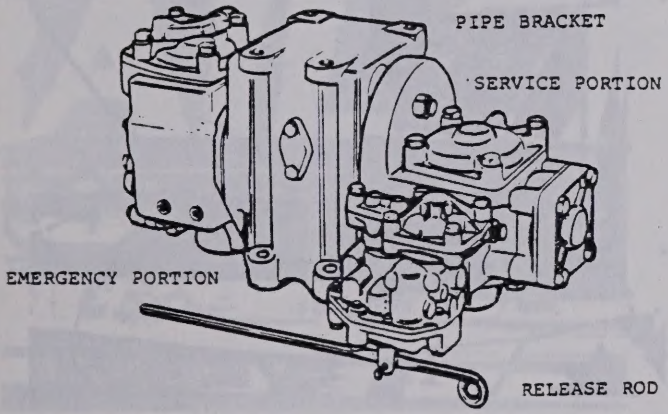


Fig. 37. ABD valve and release rod diagram.

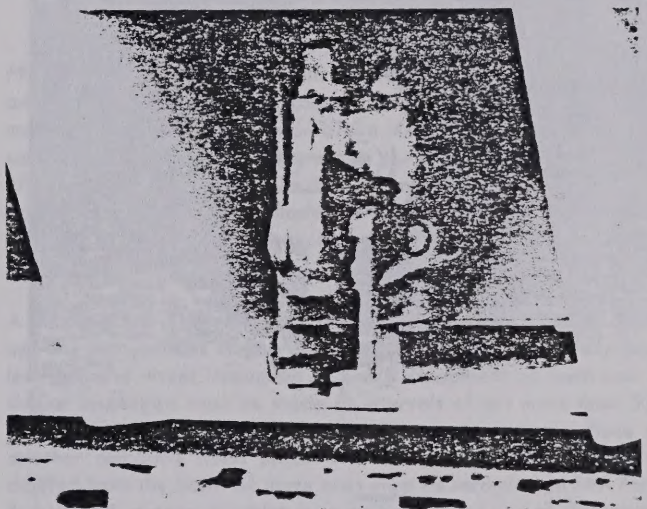


Fig. 39. Old style retainer, normal position.

In any of the above situations the offending car should be isolated from the train brake system and its own brakes released until the cause of the malfunction can be determined and corrected. So long as only one car (or a very few in a long train) is isolated, the safety of the train for shortage of braking power is not affected. Trains must have 85% effective brakes and no more than three consecutive cars with inoperative brakes. Isolation is accomplished by closing the cut–out cock between the brake pipe and the control valve. Brake release is done by pulling or pushing on the release rod which releases the air in the brake cylinder. This can only be done by a railroad employee, never by a fire agency inspector. The brake shoes may not separate from the wheels until the train starts to move but there will be no pressure on them and the piston will retract.

Retaining valves (retainers) control the exhaust of brake cylinder air. In their normal operating position the air is exhausted directly and quickly when the engineer returns brake pipe pressure to normal. Their purpose is to retain a steady pressure or a controlled slow release depending on which position the handle is set. These valves were originally developed as a safety measure which would allow the engineer to recharge his air system without losing all braking action on his train. This was quite necessary to avoid runaways by heavy trains on long down grades. Modern dynamic brakes have largely taken over the function of retainers which are seldom used now in normal operation. Retainers are still required to be installed on all railroad rolling stock as a back–up safety system. Since retainers create prolonged brake shoe pressure on the wheels, they cause overheating and sparking. Agency inspectors should, therefore, report any they observe in other than normal position.

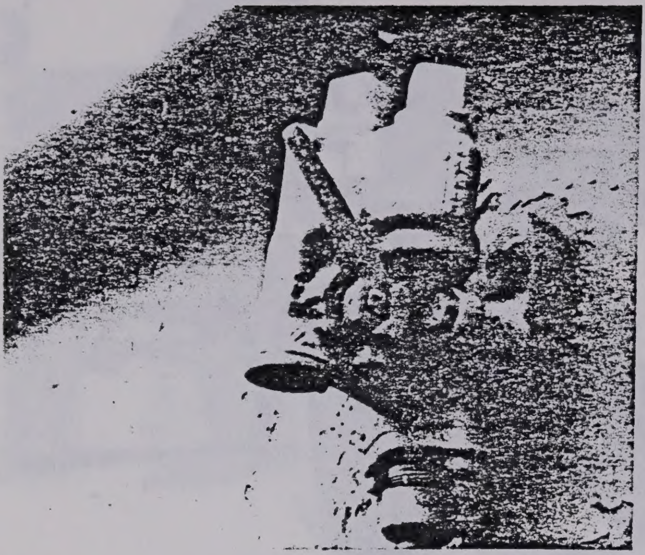


Fig. 40. Old style retainer, set.

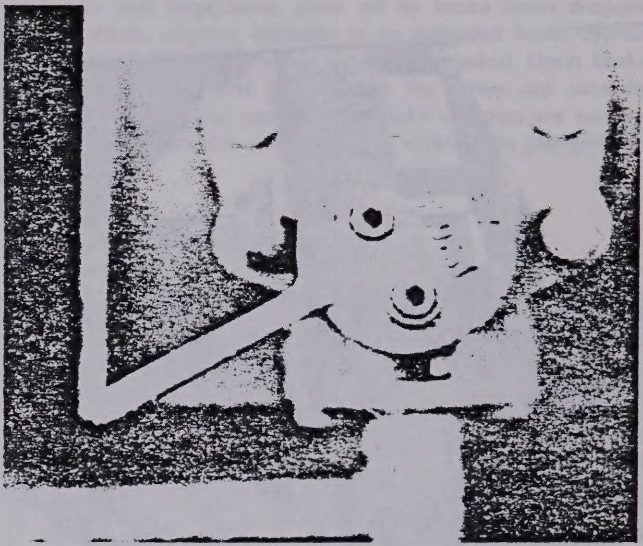


Fig. 42. New style retainer, set.

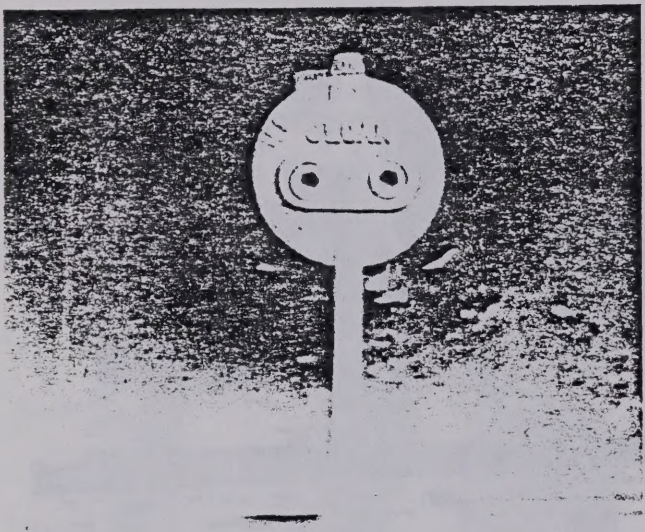


Fig. 41. New style retainer, normal position.

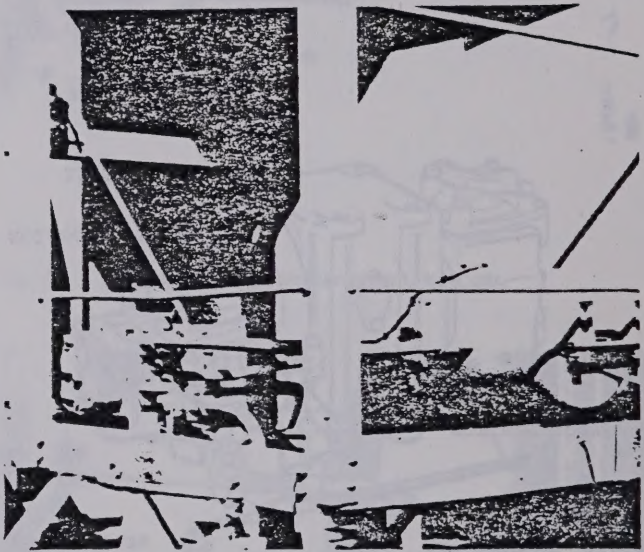


Fig. 43. Brake equipment, hopper car.

The various items referred to above—brake cylinder and piston, cut–out cock, control valve, release rod, retainers—are located in different places on different types of cars. This is particularly true of specialty cars, eg., automobile cars, hopper cars, tank cars, etc. Anyone who is expected to inspect railroad rolling stock should make it a point to learn the configuration of as many types of cars as possible.

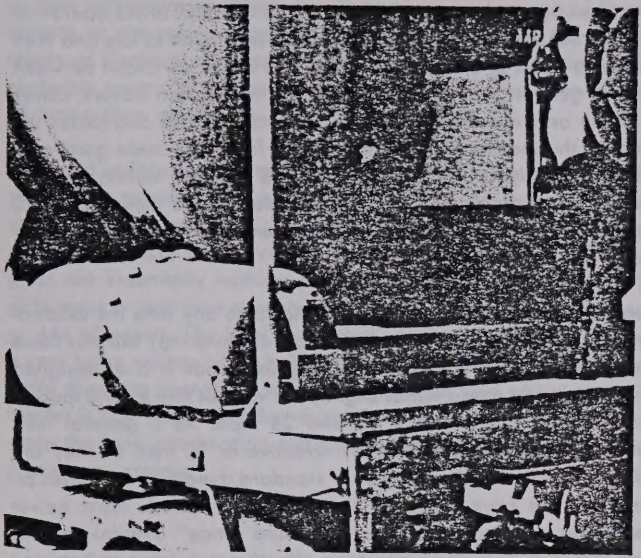


Fig. 44. Brake equipment, tank car.

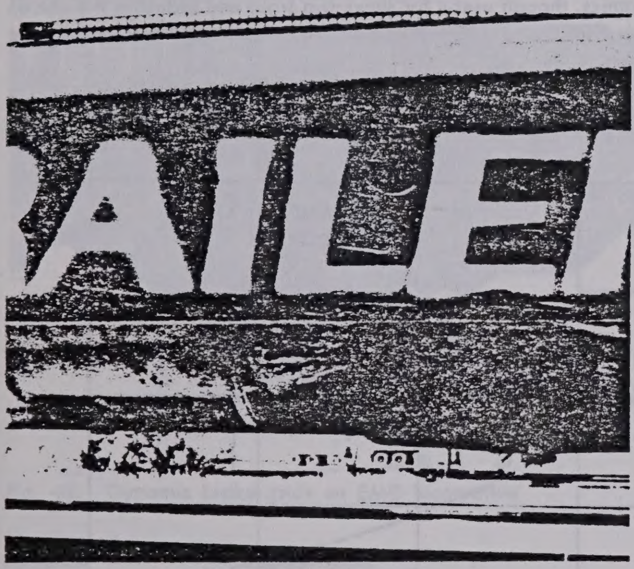


Fig. 45. Brake equipment, auto car. Must stoop to see.

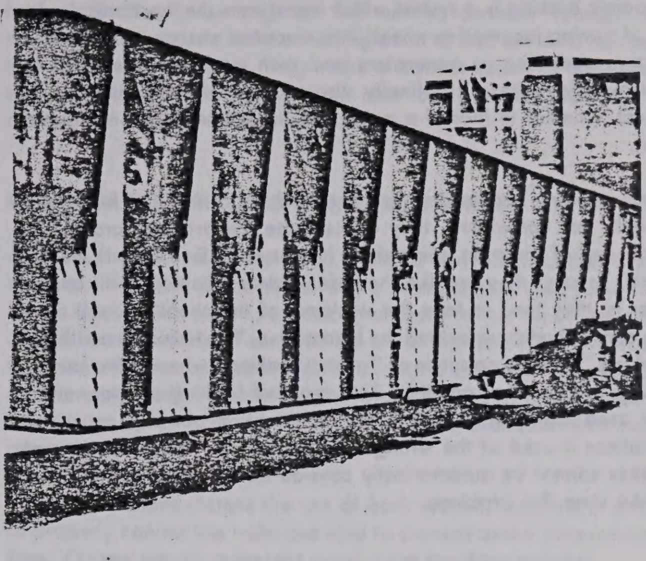


Fig. 46. Brake equipment, gondola car. Cannot see without lying on ground.

FRA rules require testing of train air brake systems at various times and places. Most operating companies conduct additional and/or more detailed tests. All these air brake tests are done to ensure train safety rather than for fire prevention purposes. They do, however, affect fire prevention because they assure that, at least at the time and place where the test is made, the brakes are operating properly, ie., there are no dragging or excessively worn brake shoes that could throw fire—causing sparks.

A complete test is made at each initial terminal where a train is made up. The test includes setting and releasing air, checking brake pipe leakage and visual inspection of brake equipment on each car. A similar inspection must be made at intervals of not more than 500 miles, where interchange from one company's tracks to those of another company takes place and where cars are added to or deleted from the train. All these tests must be recorded on FRA Form F–6180–48, a copy of which is to be kept in the cab of the control locomotive until the train arrives at its final terminal. (49CFR232.10–232.19 incl.)

Most Amtrak cars (those built since about 1970) do not use brake shoes. They are equipped, instead, with disc brakes. The discs are mounted on the insides of the wheels and are very difficult to observe or inspect. Fortunately they are all composition and rarely spark. Because of their location any sparks that may occur are directed between the rails; thus they are not likely to cause a fire anywhere except possibly in ties.

DYNAMIC BRAKES

Dynamic braking is a system which transforms the mechanical energy of turning locomotive wheels into electrical energy in the traction motors operating as generators and then into heat energy in the resister grids where it is finally dissipated to the atmosphere. The effect is similar to that of a motor vehicle decelerating on compression.

Since dynamic brakes only act to retard the rotation of locomotive wheels, not car wheels, they concentrate the braking force at the head end of the train and behind helper or RCE–1 units if present. In this respect they are like the independent locomotive air brakes. That is, they tend to take the slack out of the couplings and cause the cars to bunch up behind the locomotive. This is known as "bunch braking." It is the opposite of "stretch braking" wherein the cars are strung out as far as possible. Both types of braking are normal and are used legitimately in the proper situation but can cause real problems if used at the wrong time and place. Therefore, dynamic brakes cannot be automatically considered to be the answer to all brake shoe fire problems.

When the engineer switches from power to dynamic brake operation at his control stand, he first reduces his diesel engine to idle and then actuates a series of electrical contacts that break the circuit between the main generator and the armatures of the traction motors, closes the circuit between the traction motors and the grids and closes the circuit to the motors of the grid cooling fans. The main generator continues supplying the field coils of the traction motors but this requires very little power. An appreciable time, a minimum of 10 seconds, is required to avoid electrical damage throughout the system.

Dynamic brakes provide some retarding force any time the locomotive is moving (armatures of traction motors rotating) but this force is much less at very low or very high speeds than it is at designed speed. Designed speed varies slightly for various makes and models but generally falls between 20 and 25 mph. As a general rule, dynamics are about one–third as effective at 70 mph as they are at designed speed. Effectiveness of standard dynamics decreases on a straight line from designed speed to zero speed. Most newer locomotives are equipped with "extended range" dynamic brakes which maintain near their maximum effectiveness down to between six and ten mph before dropping off rapidly to zero. In any event dynamics, though useful for slowing a train and reducing the use of air, are not capable of bringing a train to final stop. Air must be used for this.

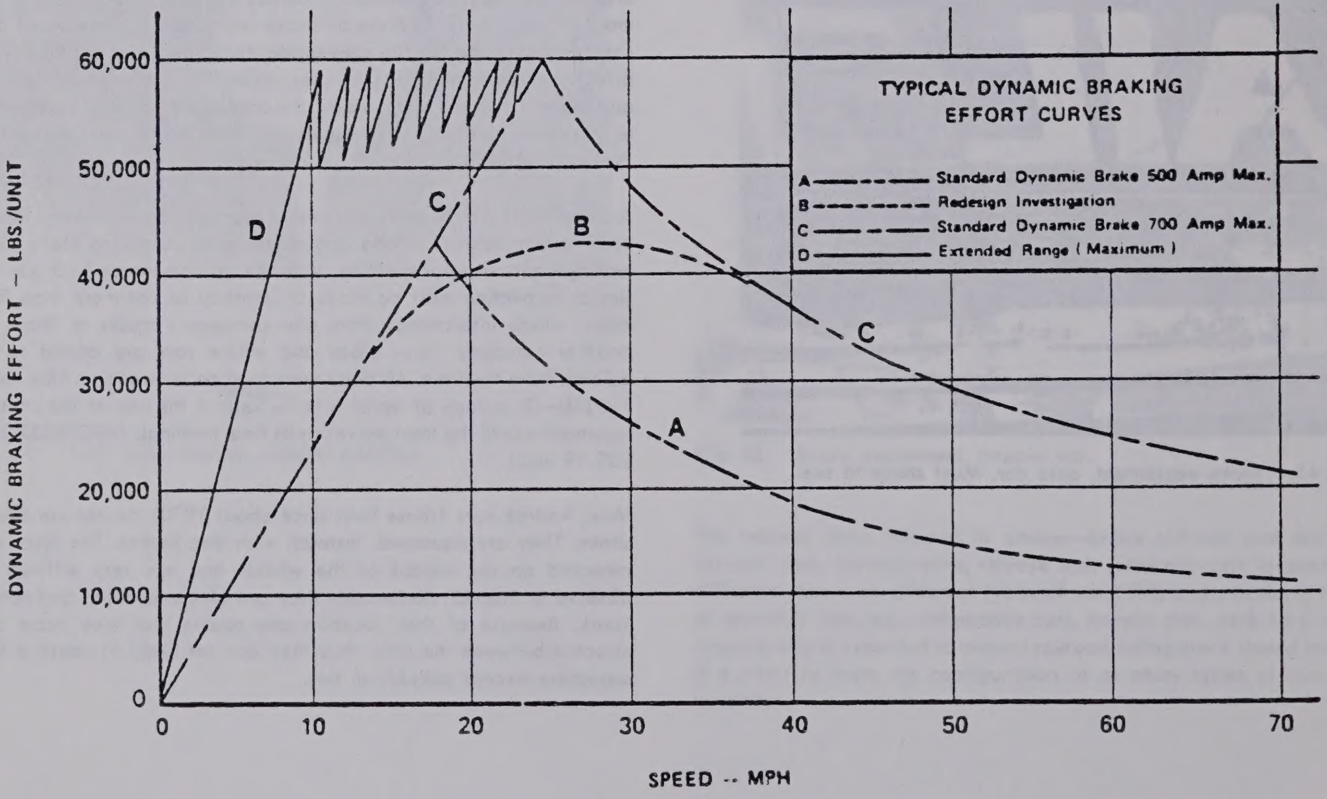


Fig. 47. Typical dynamic braking effort curves.

Various malfunctions may cause dynamic brakes to lose some or all of their effectiveness. Short circuits can happen because of foreign objects or connectors loosened by vibration. One or more of the relays or electrical controls may stick. Any of these occurrences will probably necessitate a switch to air brakes with the attendent risk of brake shoe sparks.

The most serious type of malfunction of dynamic brakes from a fire prevention standpoint is explosive arcing of the grids, which can shower molten metal for 100 feet or more. It will most often be caused by failure or seizure of a blower fan motor. Dynamic brake grids are essentially nothing more than gigantic toaster grids. The difference is that they operate at 600 volts and up to 740 amperes, or 444 kilowatts. The heat generated cannot be dissipated without a very large volume of air being blown across the grids continuously while they are operating. In fact the high–pitched whine of the fan blades is one way to tell that dynamic brakes are in use. If anything stops the fans, overheating and possible arcing of the grids can take place very rapidly.

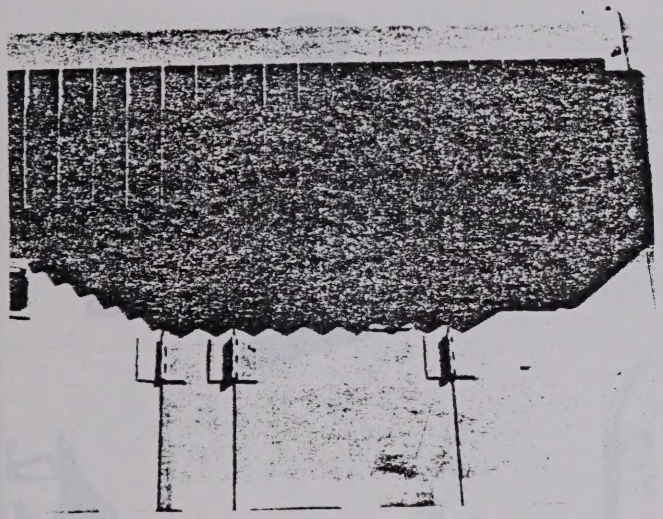


Fig. 48. Dynamic brake grids on EMD locomotive.

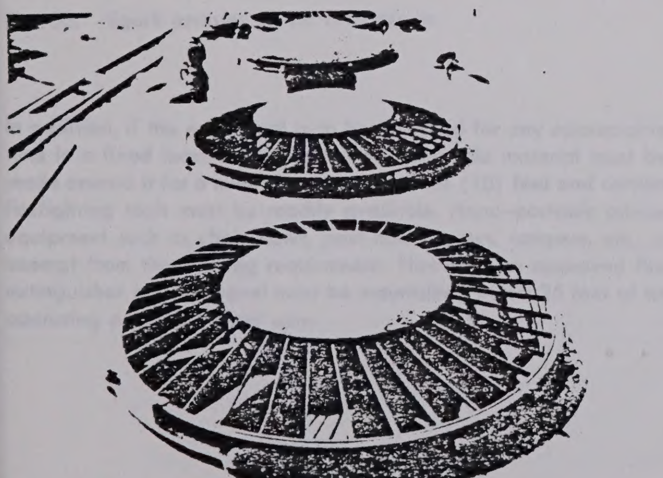


Fig. 49. Grid–cooling fans.

There is no effective method for making a standing test of dynamic brakes. Ordinarily an engineer will run his controls through the dynamic braking cycle before starting a run to find out if his controls and relays are operating. They make a distinct sound as they open and close, but the engine or train must be in motion before any current will register on his meters.

COMBINATION AIR AND DYNAMIC BRAKING

A skillful engineer seldom relies on either air or dynamic brakes alone to control his train. Of course a failure of one system may force him to use the other. It is not particularly unusual to rely on air because of failure of dynamics. Failure of the air brake system is more likely to cause either a train separation or a locking up of all the air brakes on the entire train, possibly causing a derailment. In any case a reliance on dynamic brakes with no air brakes available never happens.

Several situations dictate the use of both systems together in order to properly control the train and also to prevent brake shoe—caused fires. Others merely represent good train handling practice.

When the train is moving faster than 25 mph or slower than 20 mph (6–10 mph with extended range dynamics) it is difficult to achieve the desired control with dynamics alone. In the higher speed ranges it may also be dangerous. Therefore, combination braking is usually called for.

Sometimes a train will be too heavy to be controlled with dynamics alone. Depending on locomotive design characteristics, operating speed and grade, a set of dynamic brakes will hold back on a downgrade between 80% and 100% of the load that the same locomotive will pull upgrade. Trainmasters are not supposed to overload trains, but they are human and sometimes make a mistake. In this event the engineer will have to supplement his dynamics with air.

Except for switching, car pick–up and some short–haul operations, trains are rarely operated with a single locomotive. A group of two or more locomotives is called a "consist." The dynamic brakes on all locomotives in a consist are operated as a unit. The weight of the train and the grades to be negotiated determine the size of the consist. If one or more of the locomotives in the consist loses its dynamic brakes the remaining units will probably not be enough to control the train without supplementing with air.

Other situations calling for simultaneous use of dynamic and air brakes have to do with "stretch" and "bunch" braking. They may also involve judicious use of the throttle. The purpose is to control the amount of slack in the couplings between the cars. This has important effects on power needs in starting a train to move, negotiating humps or hogbacks and sags or dips as well as in avoiding damage to cargo and rolling stock by jerky operation.

MAINTENANCE AND EMERGENCY EQUIPMENT

Another source of fire risk is the maintenance and emergency equipment used by railroad companies. Such equipment may be used either for routine maintenance of rights–of–way, tracks and rolling stock or for clearing derailments and other calamities to restore traffic. Included are various internal combustion engine–driven machines, welders, cutters, grinders, etc. The use and operation of such equipment is subject to most of the same laws, regulations and fire–safe practices as are locomotives and other components of trains plus some additional ones.

ENGINE POWERED EQUIPMENT

This category includes everything from speeders and hyrailers through air compressors and mobile cranes to bulldozers and chain saws. Any such equipment, except licensed highway vehicles, must be equipped with an effective spark arrester. The arrester may be of either the attrition, trap or screen type so long as it is installed and maintained in such a way as to prevent the discharge of carbon particles larger than the legal size. If there are two or more engines on a single piece of equipment each must have a spark arrester.

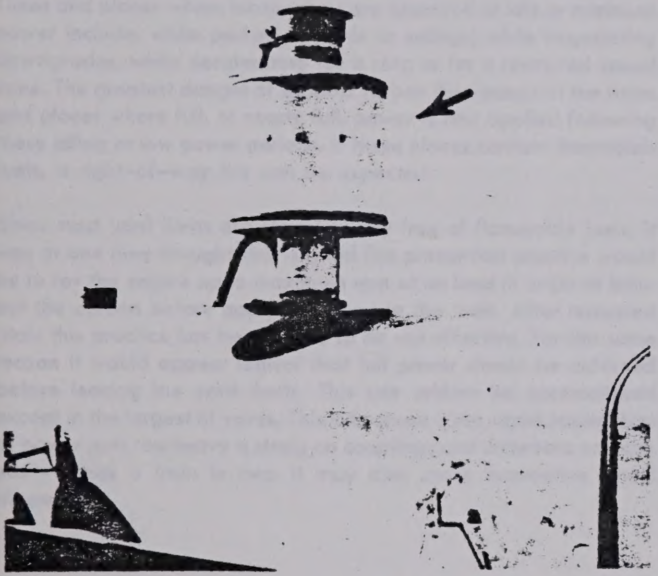


Fig. 50. Spark arrester on air compressor.

In addition, if the equipment is to be operated for any appreciable time in a fixed location, a clearing of flammable material must be made around it for a minimum distance of ten (10) feet and certain firefighting tools must be readily available. Hand–portable power equipment such as chain saws, post hole diggers, tampers, etc., is exempt from the clearing requirement. However, an approved fire extinguisher and/or shovel must be maintained within 25 feet of an operating portable power saw.

Though not specifically covered by law or regulation, in most jurisdictions refueling, especially with gasoline, is a hazardous operation. It should only be done with the engine stopped and in an area cleared of flammables for at least ten (10) feet in all directions. If at all feasible, the engine should be moved from the refueling site and the exhaust aimed away therefrom before restarting it. This is especially true of hand–portable units such as chain saws.

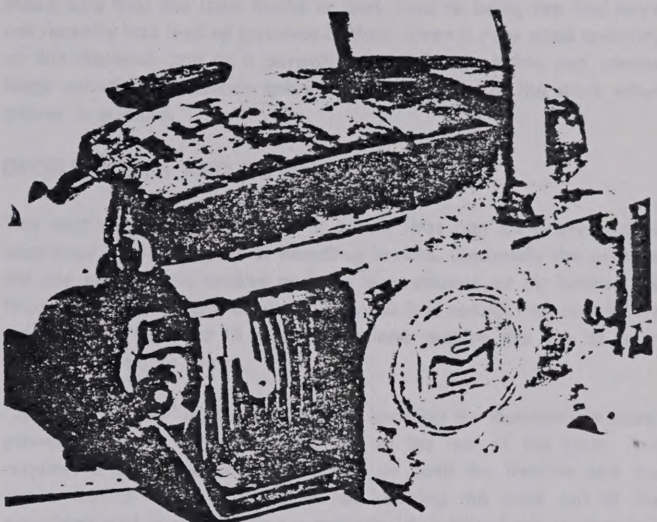


Fig. 51. Spark arrester on chain saw.

WELDING, CUTTING AND GRINDING

Permit requirements for these types of work vary between jurisdictions. It will be necessary for railroad supervisors who will be conducting them to learn the local requirements and comply with them.

Whether permits are required or not, clearings of ten (10) feet or more and readily available firefighting tools will be required. Most companies have water tank cars available. It is good practice to have one of these either at the site or at the nearest siding whenever any of these operations take place during fire season. Another fire–safe practice is to leave a watchman at the scene for a minimum of one (1) hour after cessation of the work. This is a requirement on logging operations and has been found to pay off in terms of sleeper fires discovered and put out.

EXPLOSIVES

The manufacture, sale, transportion, storage and use of explosives are regulated by both federal and state law and regulations. These laws and regulations are administered by law enforcement, rather than fire agencies. However, if the laws and regulations are violated, not only blast damage but fire can be expected. Some fire agencies require blasting permits in addition to the explosives permits in order to guard against this eventuality. In any event, explosives should not be detonated by cordite fuse or primacord.

TRAIN OPERATIONS

The likelihood of right–of–way fires caused by trains can be considerably affected by the ways in which locomotive engineers operate their motive and braking power. It can also be affected by the ways in which trainmasters make up trains, management or control agencies set speed zones and even the ways in which track is laid. Some of these effects will be discussed in this chapter.

IDLING AND ACCELERATION

The time of maximum carbon accumulation in both diesel and steam locomotives is when they are idling or operating at minimum power output. This is because less efficient combustion of fuel takes place at that time and also a slower, cooler and less voluminous flow of exhaust gasses allows carbon to be accumulated at various obstruction points in the exhaust system.

The time of maximum carbon ejection from a locomotive, assuming no mechanical defects, is when full power is applied after a period of idling. This occurrence is caused by the vastly increased flow of exhaust gasses breaking loose accumulated carbon and blowing it out of the stack. The carbon so released includes both cylinder and eductor carbon on diesel engines so equipped.

Times and places where locomotives are operated at idle or minimum power include: while parked in yards or sidings, while negotiating downgrades, while decelerating for a stop or for a restricted speed zone. The greatest danger of exhaust carbon fires occurs at the times and places where full, or nearly full, power is first applied following these idling or low power periods. If these places contain flammable fuels, a right–of–way fire can be expected.

Since most yard limits are almost totally free of flammable fuels, it was at one time thought that a good fire prevention practice would be to rev the engine up to maximum rpm at no load in order to blow out the carbon before applying power to the train. After repeated trials this practice has been found to be not effective. For the same reason it would appear logical that full power should be achieved before leaving the yard limits. This can seldom be accomplished except in the largest of yards. This is because a too rapid application of power puts too heavy a strain on couplings and drawbars and can easily break a train in two. It may also cause locomotive wheel slippage.

Other than yard exits, the areas most likely to be plagued with exhaust spark fires are at the transitions from low to medium or high speed zones, where long downgrades change to level or upgrade track and where changing from level to steep upgrade track.

A related but different problem may arise on those relatively rare occasions when it is necessary to refuel a locomotive at a place other than a regular servicing area. Particular care must be exercised to make sure that the tank trucks or cars used to bring the fuel have not recently had leaded gasoline in them. Even a very small quantity of this material acts as a purgative in a diesel engine and causes large quantities of carbon sparks to be blown out of the stack when power is applied.

DECELERATION AND DOWNGRADES

This section will discuss ways in which fires can be prevented or increased by the manner of handling brakes. Generally the greater the use of dynamic brakes and the less reliance on air brakes the fewer will be the right–of–way fires. But it is not all that simple. As indicated in Chapter III many situations require the use of both together or of air alone.

"Stretch braking" is accomplished by keeping the locomotives under power while the air brakes are set on the rest of the train. This requires a light and balanced touch on both the throttle and the brake control valve. It is useful for keeping the slack out of the couplings and thus providing a smooth ride without the jarring that sometimes takes place when cars run together. It can, however, create severe drawbar stress. It can also, when practiced for an extended time as on a long downgrade, cause excessive heating of brake shoes and wheels, which in turn can cause sparking and chipping. The practice is frowned upon by railroad management in most companies as well as by fire protection agencies if done for more than a few minutes.

"Bunch braking" happens whenever the braking force is applied at the head end of the train and the rear of the train is allowed to run up toward the head. Any of three methods of braking create this condition: dynamic braking, independent locomotive air brakes, retainers. The first two are obvious because they operate on the locomotives only. The third results from the fact that when retainers are activated they are set on the appropriate number of consecutive cars beginning at the head end. Dynamic and independent air brakes seldom cause fires. Retainers, however, can easily cause overheating of brake shoes and wheels and, consequently, fires.

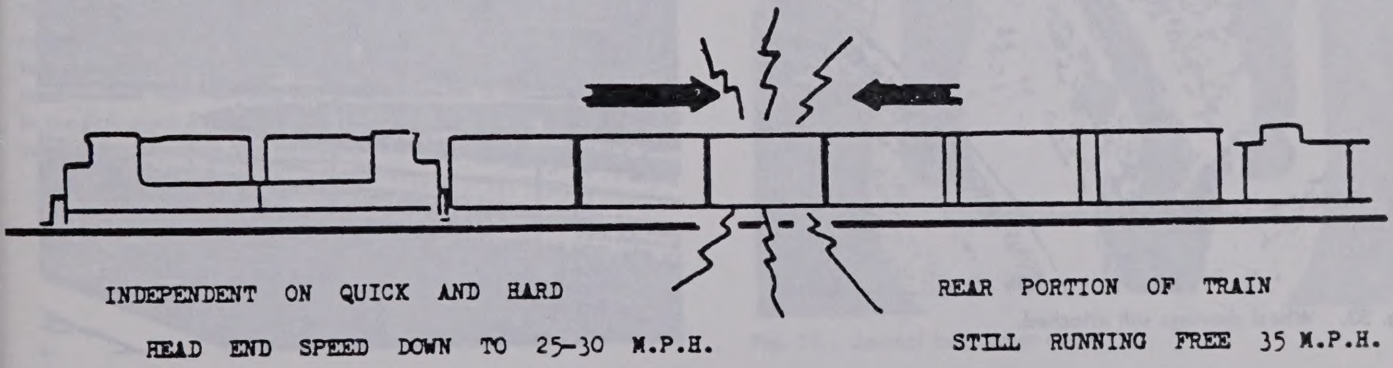

INDEPENDENT ON QUICK AND HARD
HEAD END SPEED DOWN TO 25–30 M.P.H.
REAR PORTION OF TRAIN
STILL RUNNING FREE 35 M.P.H.

Fig. 52. Bunch braking diagram.

Many times, especially during combination air and dynamic braking, the air brakes are given less than a full service brake pipe reduction, ie., 6–8 psi vs. 23–26 psi. If there is excess friction or slack in the brake rigging (linkage) on any cars in the train a simple release of this minimum set often will not release the brakes on those cars. Stuck or dragging brakes will result. The way to overcome this problem is to increase brake pipe reduction to, or near to, full service for a few seconds before moving the brake valve handle to the release or run position.

Emergency (maximum) application of air brakes will not normally start fires from brake shoes unless some were faulty beforehand. Although maximum pressure is applied by the shoes on the wheels the train is usually brought to a stop in a short enough time that excessive heat is not built up in the shoes. Of course, if any shoes were badly worn or broken at the time, they would be likely to chip, break or wear through and thus cause fires. Also, fires may be caused indirectly by derailment or loose or damaged cargo due to the sudden stop.

WHEEL SLIP

Slippage of wheels against the track can happen for any of a number of reasons. These may include excessive power applied to locomotive wheels, emergency braking, retainers, dragging brake shoes, unreleased hand brakes and various malfunctions in the brake system as a whole. A related but different phenomenon is the rubbing of wheel flanges against the side of the rail on curves.

Both of these occurrences produce flakes or chips of metal which can be found along most any railroad right–of–way. However, they present a distinctly different appearance. Wheel slip creates flat shavings which sometimes build up on each other for several thicknesses and become welded together by the heat of formation. Rail chips caused by flange wear are usually long, slender and pointed with one side quite rough. The rough side is where the metal fatigue in the rail finally caused the chip to break off.

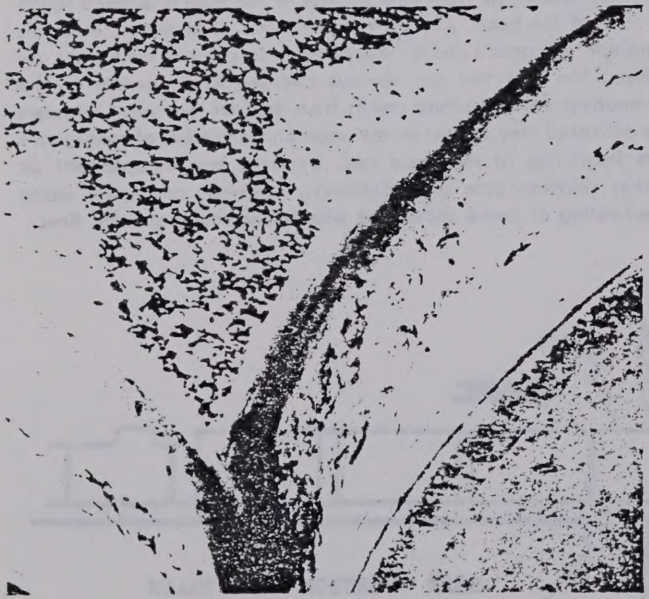


Fig. 53. Wheel shavings still attached.

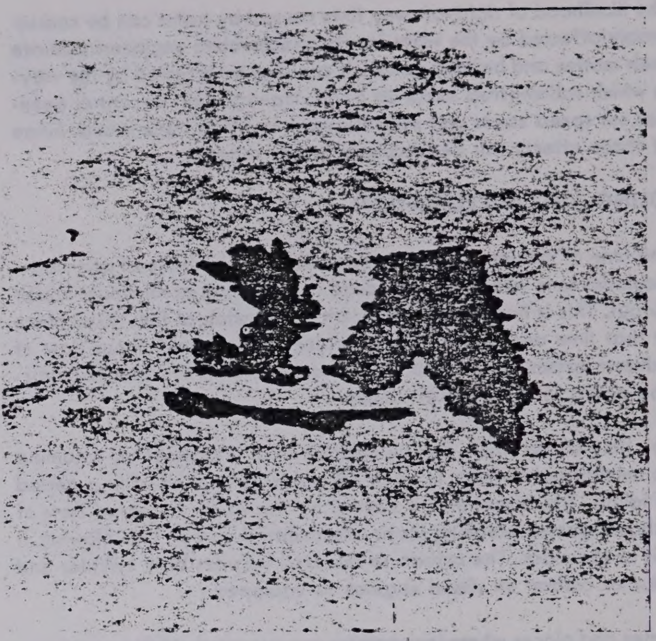


Fig. 54. Wheel shavings (top) and track splinter.

Although both types of chips can be found which have been blued by heat they do not often cause fires, except occasionally in old ties, because they normally adhere to the wheel or rail for a considerable period of time after formation before separating and falling off. Also the rail chips are not thrown by the momentum of the train but fall between the rails.

TRAIN COMPOSITION

The way in which a train is made up will determine to a large extent what the engineer can or must do with both his throttle and his brakes, especially on undulating grades and curved tracks.

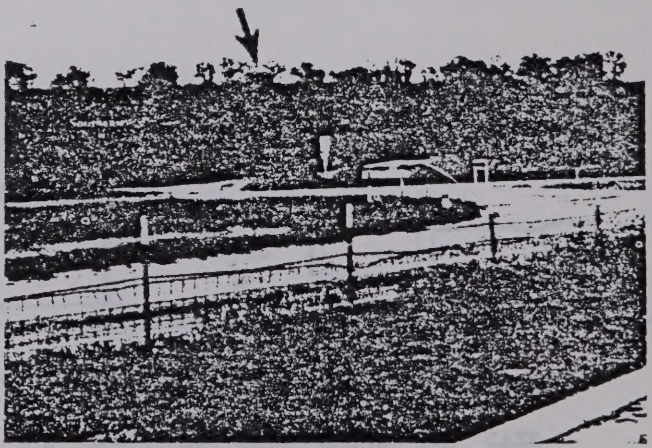


Fig. 55. Helper engines in middle of train.

Heavy cars have much more inertia and resistance to movement than light cars. They also have more momentum when in motion. Thus, if placed at or near the rear of the train with light cars in front of them, heavy cars will tend to pull the light cars off of the insides of curves if too much motive power is applied. On downgrades this same configuration will tend to cause the light cars to roll off the outsides of curves or to jackknife, even on straight (tangent) track, if either air or dynamic brakes are applied too quickly.

The handling of long or heavy trains can be enhanced by adding helper engines and/or repeater cars, either in the middle or at the rear of the train. Helper engines may be either manned or remotely controlled (RCE–1). They assist both under power and while braking, with either air or dynamic brakes. Repeater cars carry only an air compressor, air reservoir and pneumatic repeater relay unit to augment operation of the air brakes on the rear portion of the train. Any of these units help overcome some of the adverse forces mentioned above and thus reduce the probability of fires.

SPEED ZONES

Speed zones are established for a variety of reasons: grade, curvature, populated areas with grade crossings, condition of road bed, normal stopping points, etc. The allowable speed in the zone itself has some effect on the width of R/W hazard reduction required, ie., faster speed calls for wider clearing. This is because the momentum of the train and the air currents caused by it combine to throw both brake shoe chips and exhaust carbon a greater distance.

Of even greater importance, however, is the transition zone between one speed limit and another. The greater the difference between the permitted speeds the larger the problem. When proceeding from a restricted speed zone to a high speed zone full power (throttle position 8) is usually used, unless some other factor dictates otherwise. As discussed in Section A of this chapter, this acceleration will cause blowing any accumulated carbon out of the stack.

When entering a restricted speed zone from a high speed zone it is usually necessary to use brakes. If a relatively small speed change (less than 20 mph) is required it can often be done with dynamic brakes alone. If a large speed reduction is required air brakes will usually be necessary even if dynamics are also used. The obvious fire prevention solution is to start braking sooner and more easily. This can be assured by company management if graduated speed zones are established in steps of 10 to 15 mph.

DETECTORS

There are two basic types of detectors in several models used by railroads. Most fire agency personnel have heard of hot box detectors and many think that increased numbers of them would solve most of their right–of–way fire problems. This is not necessarily so. In the first place R/W fires caused by hot boxes, although common in the past, are quite rare nowadays. The box referred to in the term is the journal box which is no longer used in new construction. It has been replaced by sealed roller bearings. Although many old cars having journal bearings are still in service, the method of lubricating them has been changed and the boxes have covers. Secondly, the detectors are beamed at a narrow band just wide enough to detect incipient journal or axle heat failure which would lead to a derailment. Although brakes shoes are at approximately this height above the rail, they are usually shielded from the detector by the truck frame. Also, when brake shoes start to fail it is usually at the lower end and out of the detector beam.

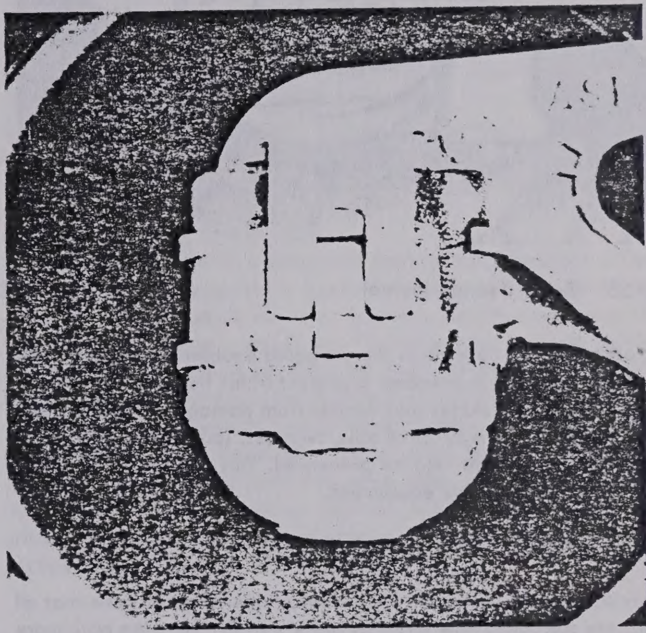


Fig. 56. Journal box, cover closed.

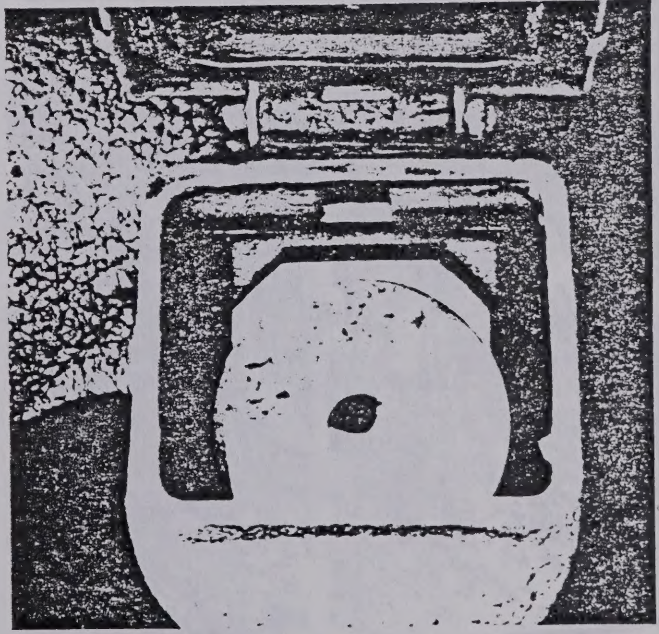


Fig. 57. Journal box, cover open.

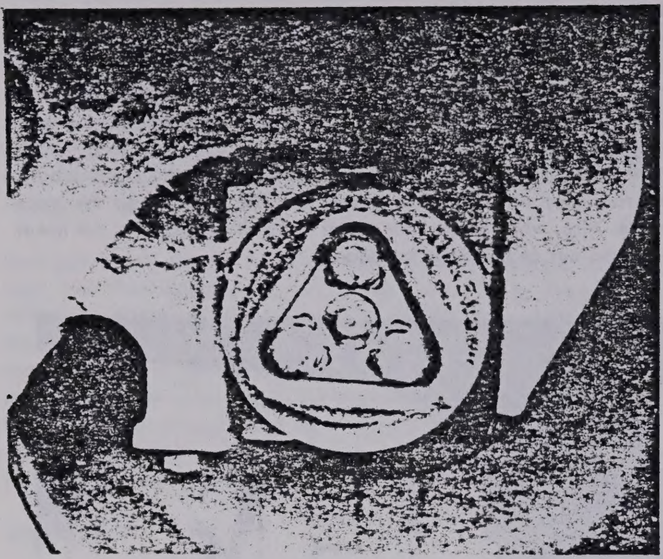


Fig. 58. Roller bearing journal.

The other type of detector is the dragging equipment detector. This piece of apparatus is intended to protect trains from derailment and structures such as bridges and trestles from damage. If the dragging item is metal which may strike rails, switches, spikes, etc., and cause sparking, a fire might also be prevented. This, however, is not the primary purpose of this equipment.

BLOCK SIGNALS AND TRAIN ORDERS

Many people not connected with railroad operations assume that all trains are controlled nowadays by block signals. There are both more advanced and less sophisticated methods of controlling train movement in use. Some of the more advanced systems, eg., CTC (centralized traffic control), include a supervisory system to control the block signals, whereas normal block signals are automatic in their operation.

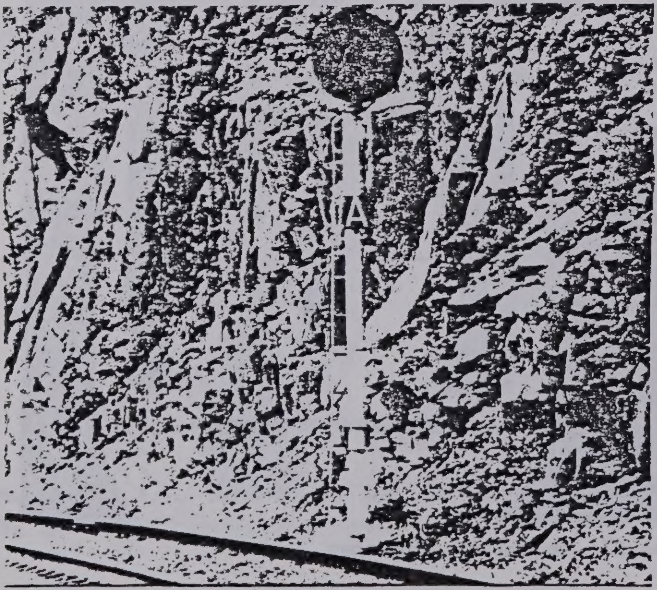


Fig. 59. Block signal.

Many hundreds of miles of track are still operated under train orders without benefit of block signals. In these areas the train crews are given written orders assigning them blocks of time to occupy certain stretches of track. Any other train, vehicle or person using or occupying that track at the same time does so at its own peril. Special rules are in effect for the safety of all in case the train is stopped, slowed or delayed from its ordered run. Since some of these areas present communication problems between train crews and dispatchers, agency inspectors should never attempt to stop a train operating on train orders unless a siding is available where it can be gotten off of the main line track. Agency personnel must learn the operational procedures for trains in their area and the locations of sidings which can be used.

AMTRAK (NATIONAL RAILROAD PASSENGER CORP.)

Compared with freight trains, Amtrak operates light weight, short and high speed trains. The FRA safety rules and AAR approved equipment are set to much higher standards because of the life safety involved. This, indirectly tends to reduce the R/W fire setting potential. Offsetting this trend to some degree are two factors unique to Amtrak.

One factor is the fact that passengers are much more sensitive than most freight cargos to jolting. Therefore, Amtrak engineers tend to use more stretch braking than do freight engineers. This means more air in different places.

The other factor tending to increase fire risks from Amtrak is the carbon accumulation in the silencer and the difficulty of cleaning the eductor which was discussed in Chapter II, Section B.

RIGHT–OF–WAY HAZARD REDUCTION

Fire risk reduction depends on activities such as those discussed in the previous four chapters. Its success is contingent on elimination of mechanical or electrical failure and human error. It is not reasonable to expect 100% success in any of these fields. Therefore, it is necessary to utilize the second approach to fire prevention: hazard reduction.

The primary method of reducing hazards is to remove them for a sufficient distance from the risks. The most dangerous hazards are: partially decomposed wood, slash, duff, dry grass, tumble weeds. If removal is not possible or feasible, as with crossties, a secondary method is used. This is reduction of flammability, usually by application of a fire retardant chemical.

Right–of–way hazard reduction is not susceptible to a simplistic approach such as clearing to mineral soil for 50 feet from the outside rail for the entire length of the R/W. This approach is not only prohibitively expensive and in some situations nearly a physical impossibility, it is also unnecessary and unsightly. It may additionally be environmentally damaging because of unusually erodable soil, rare and endangered plants, etc. On the other hand, because of unusual local conditions such as prevailing high winds and semi–desert vegetation, certain areas may require treatment that would be considered excessive elsewhere, up to 200 feet from centerline. Studies of the location of fire starts indicate that a minimum width of treatment of 27 feet from centerline (25 ft. from near rail) should be adhered to.

This chapter is organized in three sections: methods, planning and special problems. The first and third sections relate almost exclusively to right–of–way hazard reduction. The second section is concerned primarily with hazard reduction but also has some carry–over value to the reduction of risks, particularly in the field of train handling.

METHODS

There are three basic methods of reducing R/W fire hazards: mechanical clearing (physical removal), burning and chemical treatment. A subsection of this chapter will be devoted to each. A fourth subsection will deal with various combinations of the three basic methods and the times and places where combination treatment is most productive.

Mechanical Clearing

The most common method of railroad R/W hazard reduction is mechanical clearing, i.e., physical removal of the flammable vegetation and debris. This is sometimes done over an entire area from the edge of the ballast to the edge of the R/W or other desired width, and is a very positive fire prevention measure since nothing is left but bare soil. It is also quite expensive, especially if done with inefficient machinery (eg., bulldozer or end loader), and can be environmentally damaging since it exposes the soil to both wind and water erosion.

A more common use of mechanical clearing is to construct a firebreak at the outer edge of the area to be treated. This is not a very effective measure unless the area between the fire break and the ballast is also treated in some way. The farther the firebreak is from the tracks with intervening untreated fuels the less effective it is, because any fire starting in the untreated area has more opportunity to gain size and momentum with which to cross the firebreak and spread off the R/W. Firebreaks should never be left open–ended. They should always be tied into some other fire barrier, ie., the right–of–way itself, a road or highway, a river, etc. If left open–ended either a wildfire or a prescribed burn for hazard reduction can escape around the end of the firebreak.

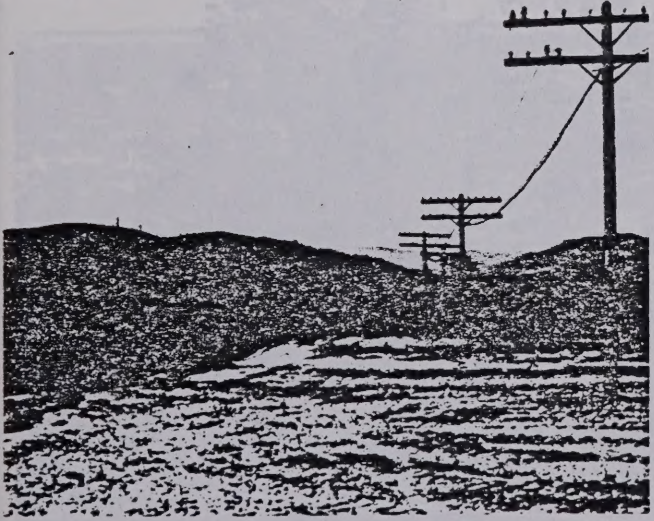


Fig. 60. Bulldozed right–of–way.

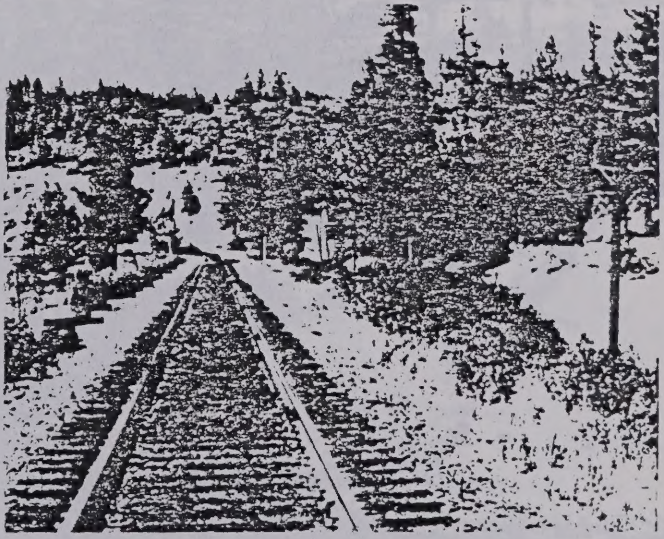


Fig. 61. Firebreak 25–30 ft. from track.

Railroad companies commonly construct and maintain their firebreaks with bulldozers. For initial construction the bulldozer is probably, in most situations, the most suitable machine. On the other hand, for annual or semi–annual maintenance it is probably the least suitable for several reasons. First, it is the slowest and most expensive machine. Both motor graders and discs will do as good a job, or better, at a fraction of the time and cost in all except steep terrain.

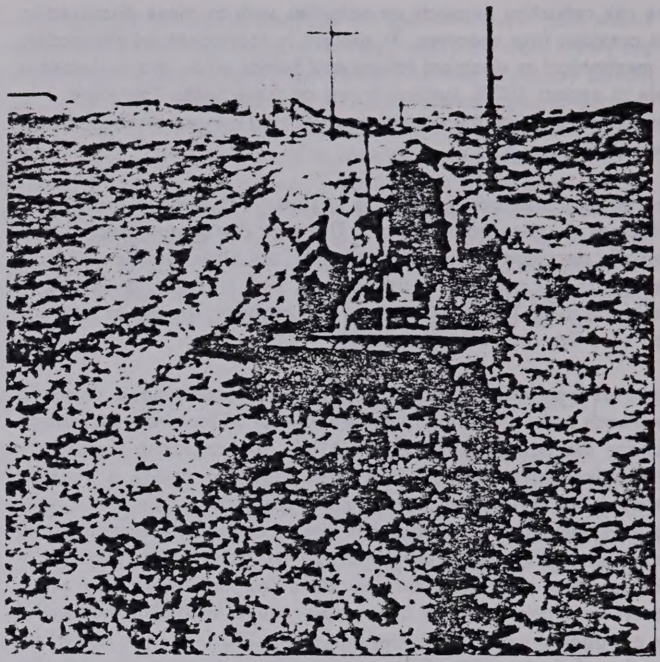


Fig. 63. Firebreak maintenance with disc.

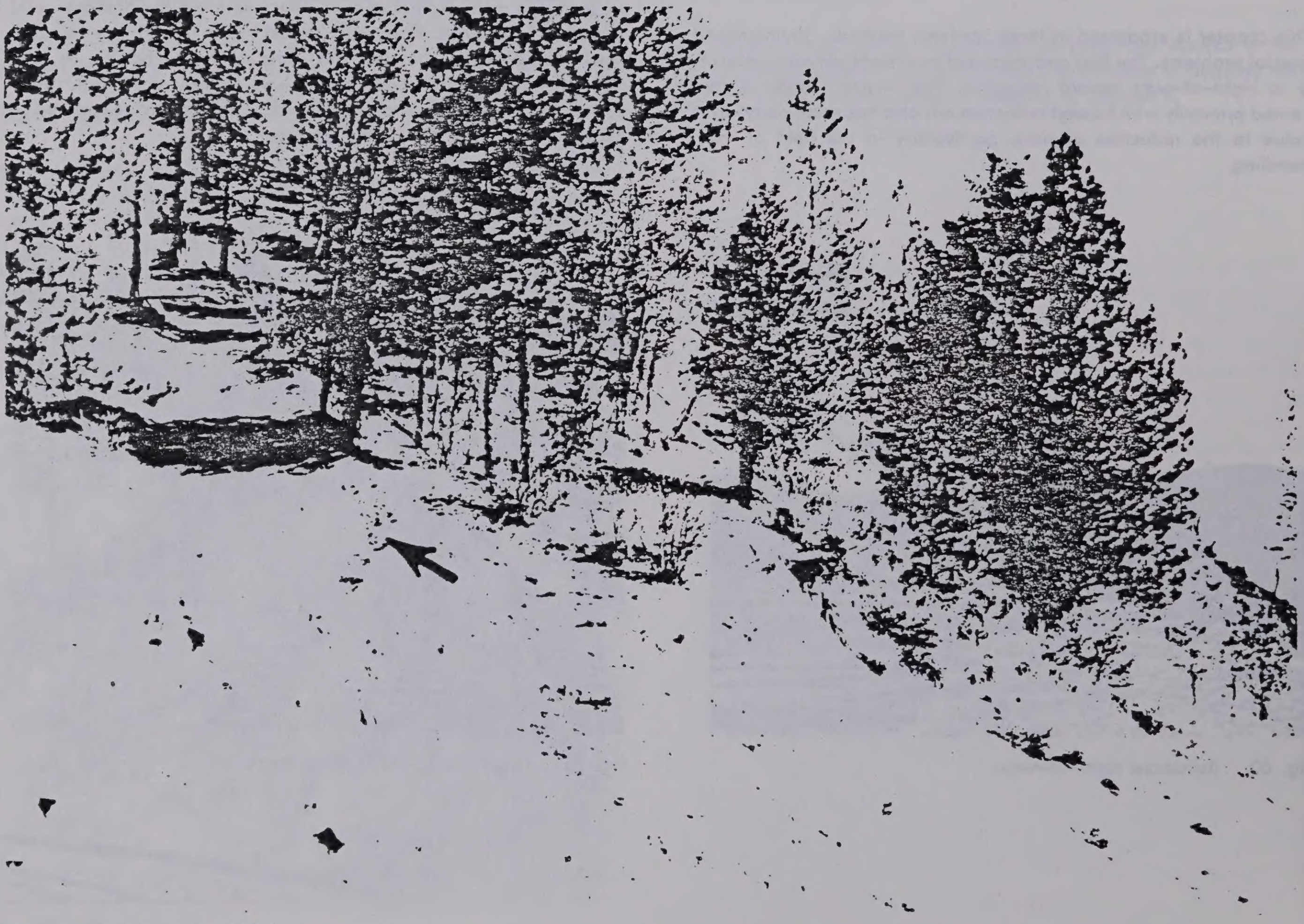


Fig. 62. Firebreak 50–100 ft. from track.

In most cases bulldozers are inferior to graders or discs for maintenance of firebreaks because they are likely to increase soil erosion. Repeated passes over the same track dig deeper and deeper and build up increasingly high berms on each side. Discs do not do this. The angle of the blade on a motor grader can be reversed on successive passes so that the previous berm is pulled back across the firebreak, thus requiring a shallower bite.

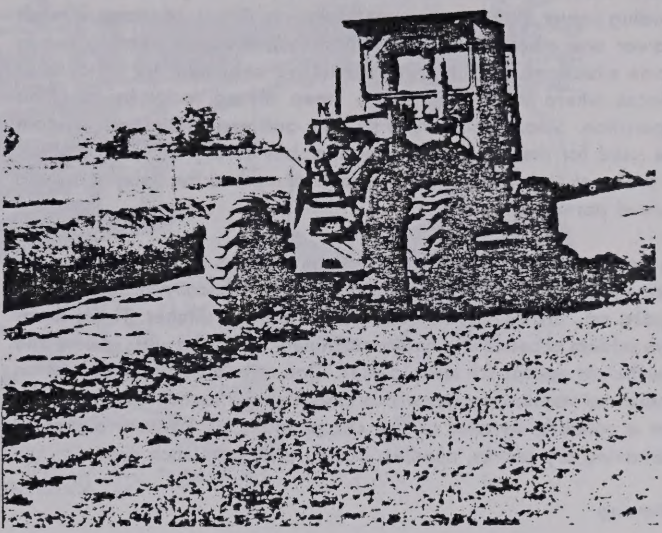


Fig. 65. Firebreak maintenance with motorgrader.

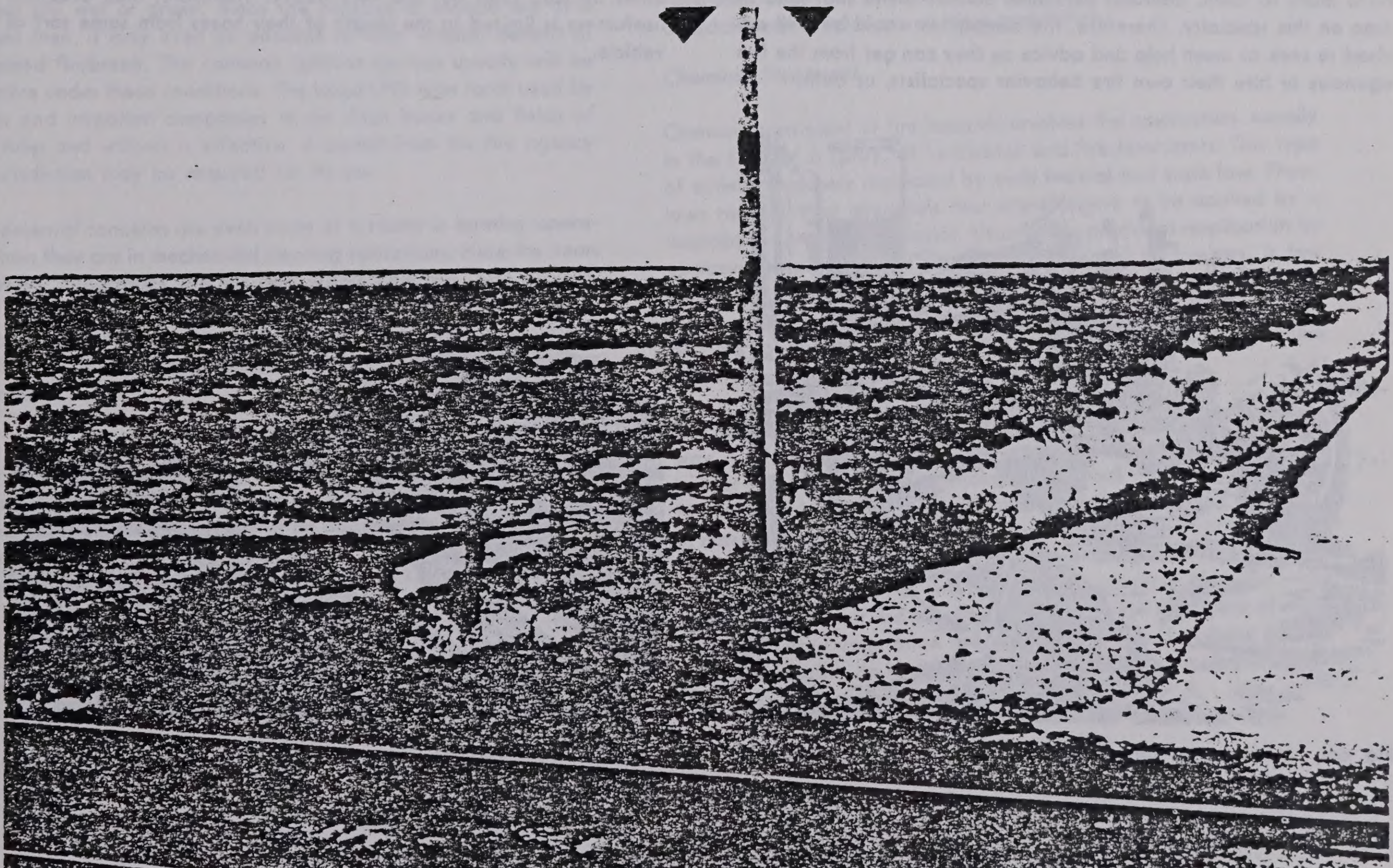


Fig. 64. Open–ended firebreak.

Another effective method of mechanical clearing is by use of hand tools. These would include shovels, axes, scraping tools, saws (including power chain saws), cant hooks, etc. This is, of course, a much slower and more expensive method than machine clearing but in some situations it is the best alternative available, for instance in places where the terrain is too steep or too rocky for machine operation. Since handwork is so slow and expensive it will seldom be used for the entire R/W clearing, but usually only to construct a firebreak. It is often the only practical method for clearing around tunnel portals.

A particularly vulnerable spot for the starting of R/W fires is the accumulation of flammable debris which typically occurs in low spots, eg., draws, culvert heads and drainage ditches. These areas are seldom accessible to heavy machinery and hand work is slow and inefficient except for large pieces. One railroad has found that an industrial vacuum cleaner with a long, flexible suction hose mounted on a speeder, hyrailer or flat car provides an efficient means of removing dry leaves, needles, paper, etc., from such areas.

Burning

In many situations burning is the only feasible way of getting rid of R/W fire hazards. Achieving the desired results with safety is not as easy or simple as some railroad personnel believe it to be. Some protection agency personnel spend a lifetime studying and learning about fire behavior, burning prescriptions and fire safety and still have more to learn. Railroad personnel cannot spend that kind of time on this specialty. Therefore, the companies would be well advised to seek as much help and advice as they can get from the fire agencies or hire their own fire behavior specialists, or both.

The laws of many states, California included, require permits for any open burning during fire season. In Southern California burning permits are required year–round. The permit is normally issued by the fire protection agency having local jurisdiction. Most fire protection agencies will not issue permits for broadcast burning such as is done for R/W hazard reduction without an on–site inspection. The terms and conditions of the permits are the minimums necessary to reasonably ensure safety to adjoining property and compliance with fire laws and ordinances. They do not ensure success nor relieve the permittee of liability in case of escape.

Right–of–way burning should only be done in accordance with a prescription drawn up to achieve a specific purpose, taking into account the specific fuels, terrain, existing weather conditions and manpower and equipment available. Very generally, this kind of burning means a light fire which will consume dry fuels and not harm live vegetation. It will usually call for burning in strips from the top of the slope down and/or against the wind. Adequate control lines must be constructed in advance and sufficient personnel and equipment must be on hand to prevent an escape. These are obviously generalities which must be made much more precise and specific for any actual job.

Ignition devices commonly used in R/W burning include fusees, drip torches and pneumatic and power flame throwers. Fusees and drip torches are very portable and easy to use on high banks or rough terrain. Power flame throwers are quite useful for igniting damp or other difficult fuels but are very heavy. Therefore, their practical usefulness is limited to the length of their hoses from some sort of vehicle.

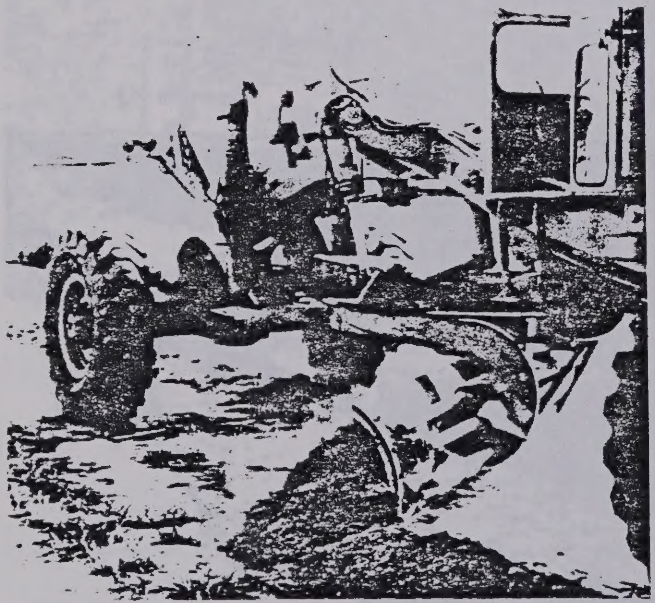


Fig. 66. Motorgrader spreading berm.

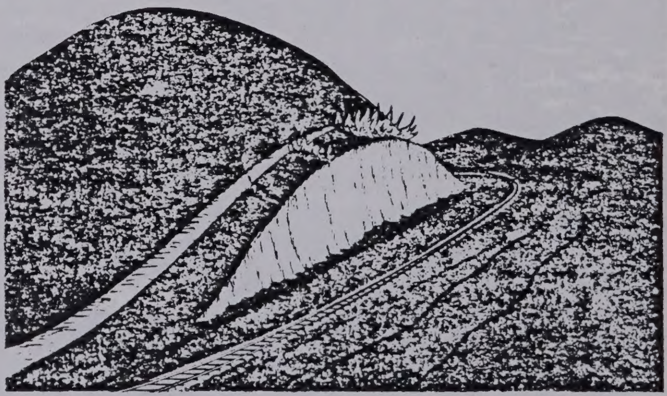
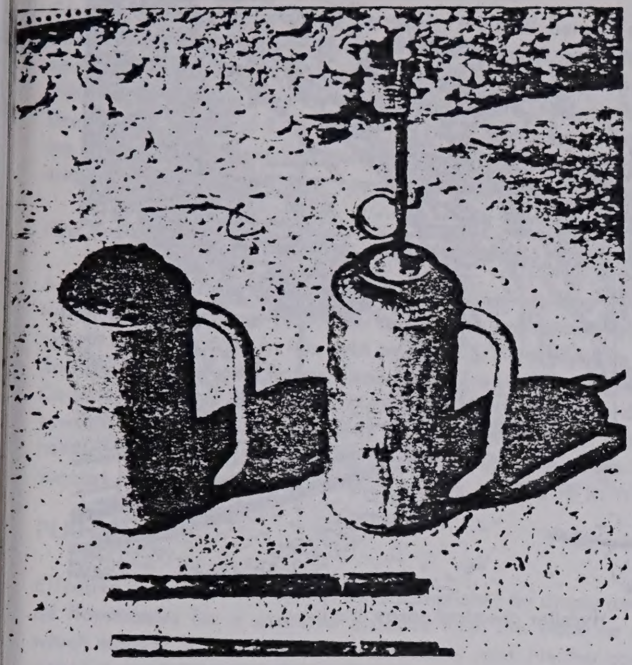


Fig. 67. Strip burning.



68.   Ignition devices.

ertain situations it is advantageous to do the burning when the ls are still wet or green. Since the chances of escape are at a imum then, it may even be possible to burn without benefit of repared firebreak. The common ignition devices usually will be ffective under these conditions. The large LPG type torch used by mers and irrigation companies to rid ditch banks and fields of ss, tules and willows is effective. A permit from the fire agency h jurisdiction may be required for its use.

vironmental concerns are even more of a factor in burning operans than they are in mechanical clearing operations. Here the items primary importance are air and water pollution. Soil erosion, ich is the primary concern in mechanical clearing, is of only minor secondary concern in burning since the roots are usually left to d the soil. Also, if the burning is done properly, the larger plants l remain.

en burning is regulated by fire laws and air pollution control laws. ny such laws state that open burning is prohibited unless the ponsible fire protection agency certifies that the material to be rned is a fire hazard that cannot be abated in any other way. For lroad rights–of–way this certification can usually, though not ays, be legitimately and honestly made.

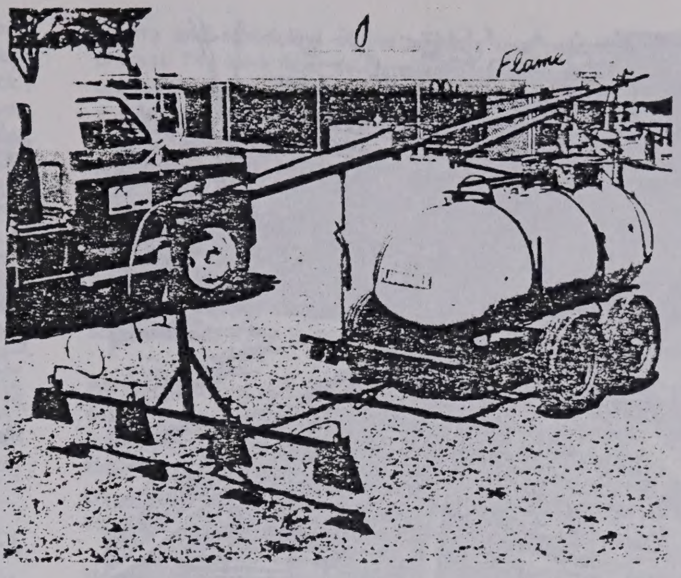


Fig. 69.   Weed burning torch.

Water pollution from R/W burning is not as likely to happen nor as easily determined as air pollution. However, if water quality control or fish and game agencies have good reason to believe that the project will dump ash and lye in injurious amounts into streams or reservoirs, they may intervene. Such intervention may take the form of additional restrictions or even prohibition.

Chemical Treatment

Chemical treatment of fire hazards involves the application, usually in the form of a spray, of herbicides and fire retardants. This type of activity is closely regulated by both federal and state law. These laws require most chemicals that are effective to be applied by a licensed or certified applicator. Usually this precludes application by company employees and dictates the hiring of contractors. A few companies do their own chemical application. In any event, maintenance–of–way personnel need to know enough about chemicals to be able to write adequate project specifications and to determine whether or not those specifications have been met.

The most common type of chemical treatment of railroad rights–of–way is with a non–selective soil–applied herbicide applied to the ballast and towpath and to enough additional width to comply with FRA (Federal Railroad Administration) regulations (49CFR213.37). In most cases, unless thwarted by adverse weather or other outside factors, this provides very good fire prevention protection within the width covered. However, two problems are common. First, the width treated may be far too narrow. Secondly, large quantities of dead and desiccated vegetation may be left at the edge of the treated strip. The result is an increase, rather than a decrease, of flammable fuels within a few feet of the track (8 to 10 feet.).

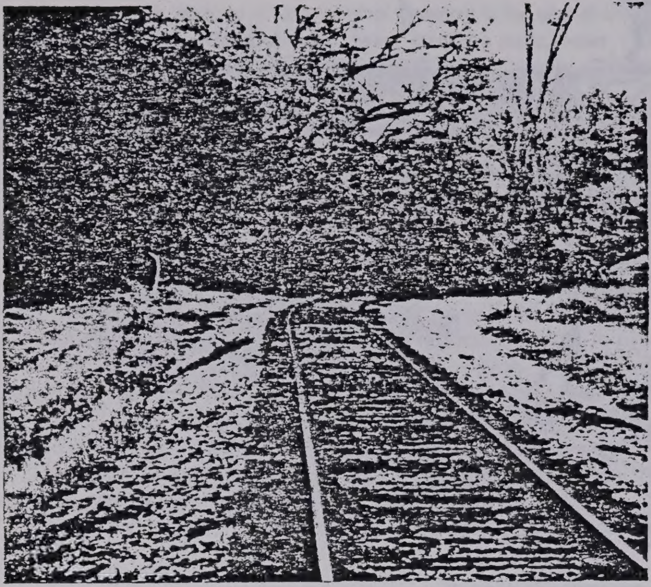


Fig. 70. R/W with narrow chemical treatment.

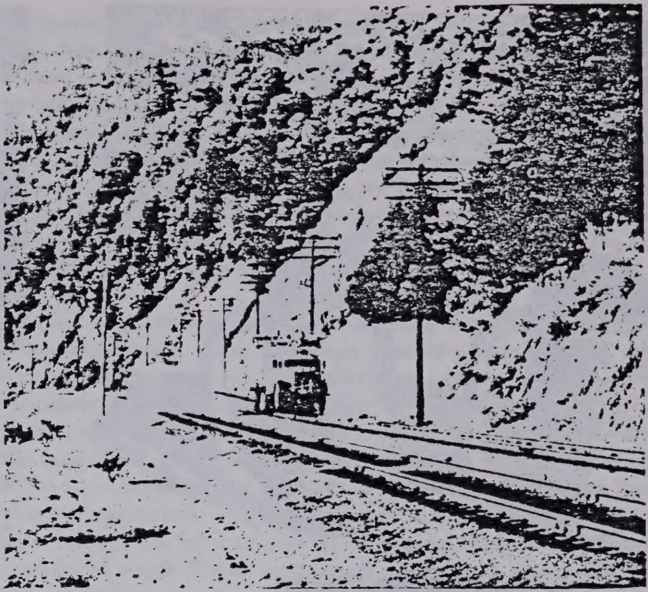


Fig. 71. Hyrailer chemical spray truck.

Where maintenance chemical applications are properly timed and made wide enough for effective fire prevention, no dead vegetation will normally be left in the treated areas. The problems discussed and illustrated above are related to either too narrow an application or reliance on chemicals alone for R/W hazard reduction.

The non–selective nature of the herbicides usually used can create two problems. One is damage to vegetation which should not be damaged, especially that belonging to adjoining property owners. The other is lack of effect on certain resistant species. Wild blackberries, salt grass and Johnson grass are good examples of the latter. They usually require supplemental treatment with a heavier dose or a specific herbicide.

Soil–applied, non–selective herbicides require rainfall or sprinkling to carry the chemical into the soil where they act to control seed germination and plant growth through root uptake. Because of the broad spectrum of plants controlled by these herbicides they must be placed carefully to avoid non–target plants. Most of these chemicals are held in place by the soil but heavy rainfall immediately after application can result in contaminated run–off water which may be damaging to non–target plants. Chemical label instructions must be strictly followed in all cases.

Fire retardant chemicals are used much more for fighting fire than for preventing it, because the ones in current use are fertilizers that are easily washed off by relatively light rainfall. At least one of the older retardants, sodium calcium borate, seems to have usefulness in treating ties. It is a sterilant, so would not promote growth of vegetation in the ballast and does not wash off as easily as many other chemicals. Though no longer used for firefighting, it is still manufactured and available as an oil well drilling mud. All fire retardant chemicals are harmful to fish. Care must be exercised to keep them out of streams.

Right–of–way chemical treatment is usually applied from specially equipped rail car or from hyrailer truck. These units are owned by the contractors and move from one railroad or division to another. This is an economically efficient arrangement. Unfortunately, it makes optimum scheduling in relation to weather and elevation at any particular place very difficult.

In a few cases chemicals are applied by railroad–owned equipment operated by company personnel. In certain other cases where particularly wide applications are necessary they are done by helicopter. These situations provide more flexibility in timing and thus usually produce very good results.

Combination Treatment

Any one of the above right–of–way fire hazard reduction methods is seldom sufficient alone. A combination of any two or all three is usually called for.

Mechanical clearing is most useful for initial clearing of heavy fuels, such as old logs, and for construction and maintenance of firebreaks. Chemical treatment is most useful for maintenance of clearings already established but can create flash–fuel problems if used as the first treatment. Burning can be used for either initial or maintenance treatment but is normally unsafe without a mechanically cleared firebreak.

It is uneconomic and usually impractical to clear the entire width necessary by either mechanical or chemical treatment. Thus, some amount of burning is ordinarily called for. Burning can be done only under permit and is dependent on favorable weather conditions. It requires considerable manpower and advance preparation to be done safely. This usually means a mechanically cleared firebreak. The area to be burned may be reduced by proper application of chemicals and proper location of the firebreak.

Certain fire hazards cannot be treated by removal, burning or herbicides. These might include, in addition to ties and wooden trestles and snowsheds, vegetation such as moss and grass growing on rock cliffs or cut–banks, rare or endangered plant species and short stretches or widths of R/W where the other methods are precluded for any reason. In these situations fire retardant chemicals should be employed, either alone or in combination with the other methods.

Fire Resistant Plants

Another approach to R/W fire hazard reduction would be the substitution of fire resistant plants for the native vegetation. Some research has been done in this field by the U.S. Forest Service Pacific Southwest Forest and Range Experiment Station, the Los Angeles County Arboretum and others. Most of this work has been directed toward landscaping for structures located in hazardous fire areas rather than large scale of R/W plantings. However, some limited success has been achieved which might be applied to R/W's.

PLANNING

Effective fire prevention cannot be accomplished by simply removing all flammables for a specified distance from the track no matter which method or combination of methods is used. Neither can it be paid for, nor is it even necessary. How then are decisions to be made regarding what to do and how, when and where to do it?

The obvious answer is through problem analysis and planning. Since no one person or organization is usually in possession of all pertinent data and expertise needed for this process, and since the implementation of solutions may be the responsibility of different departments, this analysis and planning should be a cooperative effort. It is basically a company responsibility and for efficiency and continuity one person will probably be put in charge. This person has most often been a division engineer.

Whoever is spearheading the prevention effort should not attempt to do it alone nor should he be expected to. He should have full access to, and be able to depend upon, personnel in the maintenance–of–way, mechanical and operations departments. He should also seek, and be given, data and suggestions from both fire prevention and fire suppression personnel of the protection agencies. These agencies also have specialists in other fields who can often provide valuable assistance.

In order to determine the nature and extent of the problem it is necessary to know the locations and specific causes of right–of–way fires. It is also helpful to know the nature of the fuels ignited, eg., ties, vegetation, structures, rolling stock, etc. Locations are needed not only by mile post but also by distance from center line (or near rail) and by side of track. Specific causes may point to a mechanical or operational problem.

Analysis of all this data, and any other that is available and pertinent, will reveal which sections of R/W are most susceptible to fires, how wide the treatment should be at various locations and the method, or combination of methods, which will produce the needed treatment at least cost and highest efficiency.

Timing and scheduling of the work is also part of the planning process. The work must be completed by about the opening of fire season but not so long before that it is negated by regrowth, leaf and needle fall, etc. For ease of administration and public understanding, fire season is officially opened over large areas, such as southern, central and northern California, at one time. The actual period during which fires will ignite easily and spread quickly in any local area will often begin either earlier or later than this officially declared fire season. A good example of this is the easily observed difference in grass and other light vegetation at 1000 feet above sea level and at 5000 feet on June 1 of any given year. The scheduling of R/W hazard reduction work needs to be localized.

Although hazard reduction work can often be done most efficiently as a project, it does not always have to be done this way. A good many times, if needed work is identified in advance and is not the kind that is dependent upon weather conditions, it can be done while crews are in the area on other assignments. This type of scheduling can save a great deal of production time otherwise lost to travel.

Planning and scheduling burning operations deserves special attention and coordination with other work. Because of the extreme dependence on the proper combination of weather factors for safe and effective burning, the planning of burning projects demands a great deal of flexibility and coordination with other work. Standby projects should always be available for burning crews in case weather is adverse on any given day. Similarly, the capability of redirecting crews from other projects to burning on days when the conditions are right during spring and early summer should be provided for.

SPECIAL PROBLEMS

Certain items, conditions or locations present fire prevention problems that are unusual in type or degree and deserve special attention.

One such item is used ties. It has been estimated that the average age of a good quality tie when it is replaced is 30 years. If it was originally treated most of the treatment chemical has been leached out. It may be starting to rot. If not, in most cases it is badly cracked and splintery. In any event it is an excellent fuel bed for an exhaust or brake shoe spark to fall in and start a fire unless it is removed from the R/W.

All companies have some program for getting rid of old ties, telephone poles and crossarms. Some sell them for landscaping or for building materials. Some burn them. A possible new market, boiler fuel, is being explored at the time of this writing. Despite the programs and policies in effect, it is not uncommon to observe abandoned ties, poles and crossarms on the right–of–way.

Another special fire hazard is wooden structures. These include buildings, trestles, snowsheds, tunnel linings, ties, etc. Except for ties these seldom catch fire, but when they do they create intense heat and usually cause a wildfire. In addition, the loss of a trestle, snowshed or tunnel will tie up traffic for some time. The likelihood of such structures catching fire will be markedly reduced if strict compliance with clearance laws is observed (4291 PRC). Accumulation of dry driftwood against the pilings of trestles is as much a violation as is dry grass. In–service ties and trestle timbers can be treated with a fire retardant chemical (see Section A3 of this chapter).

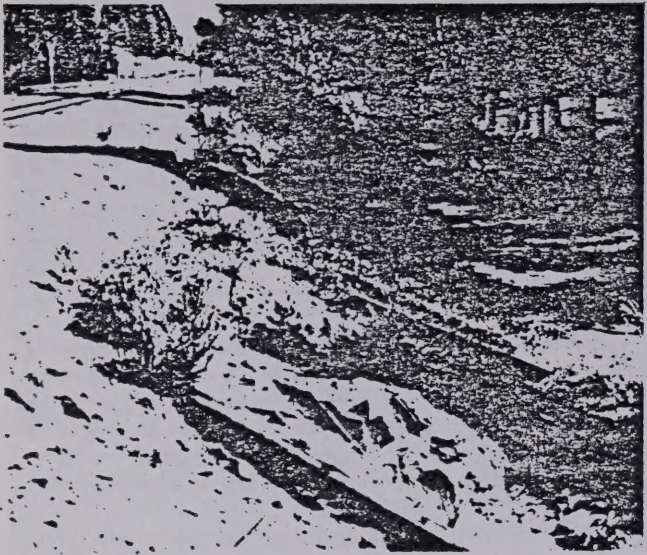


Fig. 72. Abandoned ties on R/W.

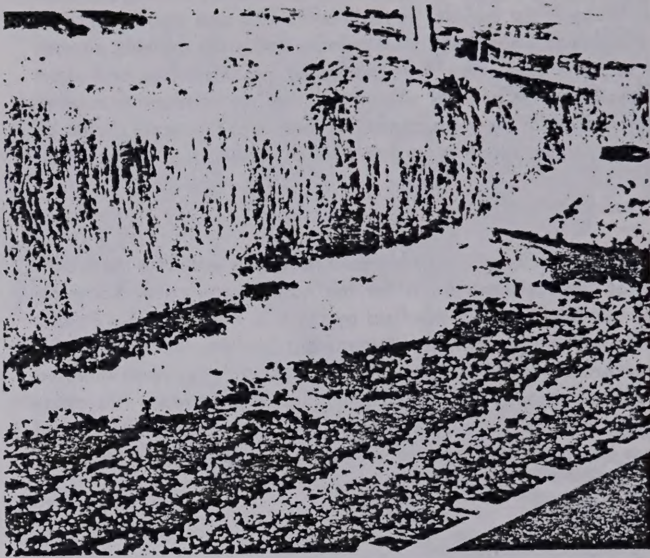


Fig. 73. Abandoned ties and poles on R/W.

Fig. 74. No problem now but what about August and September?

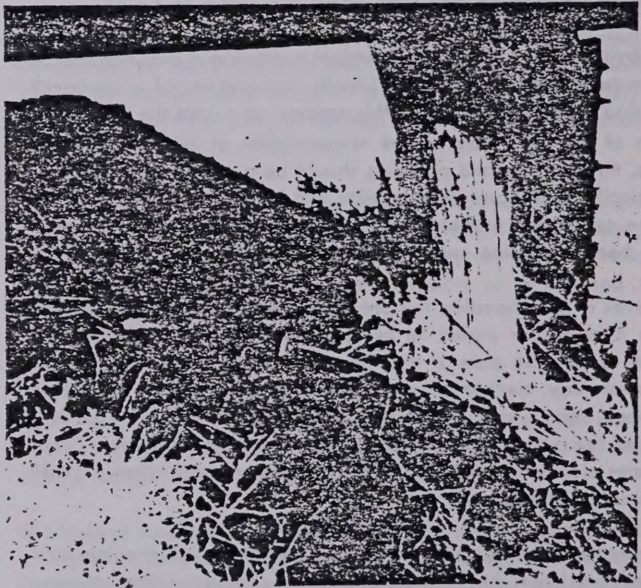


Fig. 75. Debris against trestle piling.

Leaf and needle fall exists almost everywhere and is a primary cause of the need for annual maintenance of R/W hazard reduction. Some localized areas have unusually heavy leaf or needle fall to the extent that semi–annual or even more frequent maintenance becomes necessary. In these relatively few and small areas serious consideration should be given to removing the trees far enough back from the track so that their leaves or needles will not fall in the strip to be fire–proofed.

Tunnel portals are particularly vulnerable to exhaust spark fires. The top center of the portal is the point at which the exhaust stack is closer to the ground than anywhere else on the entireR/W. If the ground there is permitted to support dry vegetation it is a direct invitation to a fire. A 40–foot clearing is recommended from this point.

Wood chips deposited on the R/W have in the past created severe fire problems. With the advent of car nettings and/or water level loading the accumulation of this hazardous fuel has been sharply reduced. On certain stretches of track, chip accumulation probably will never be completely prevented. If allowed to build up between the rails, the chips can be just as dangerous in winter as in summer but in a different way. When they become soaked with rain or snow melt they conduct electricity and short out block signals and switch controls. The affected companies therefore keep a close watch on them and vacuum or otherwise remove them before they become dangerous or a fire hazard.

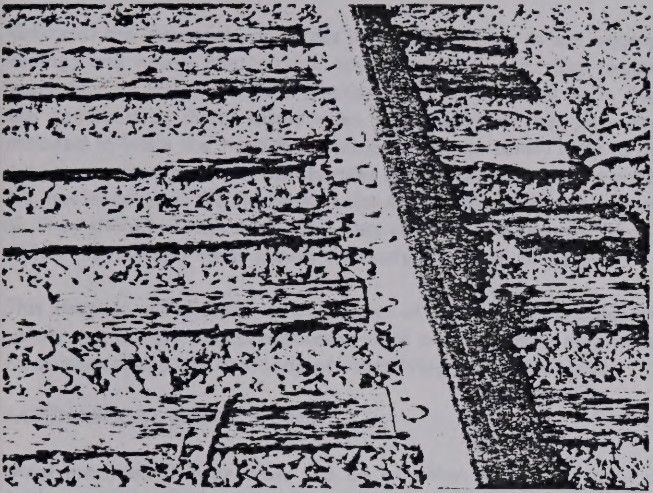


Fig. 76. Accumulation of oak leaves and twigs on R/W.

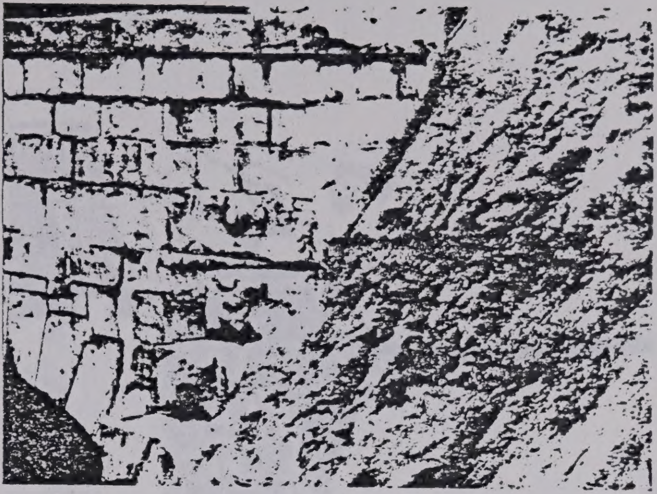


Fig. 77. Hazardous tunnel portal.

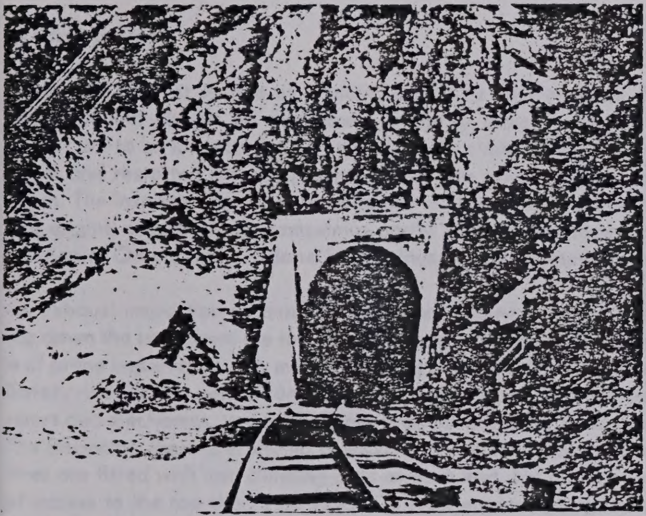


Fig. 78. Safe tunnel portal.

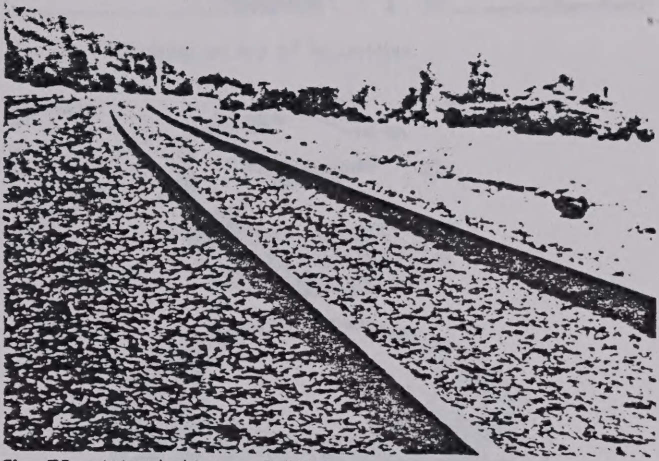


Fig. 79. Wood chips on R/W.

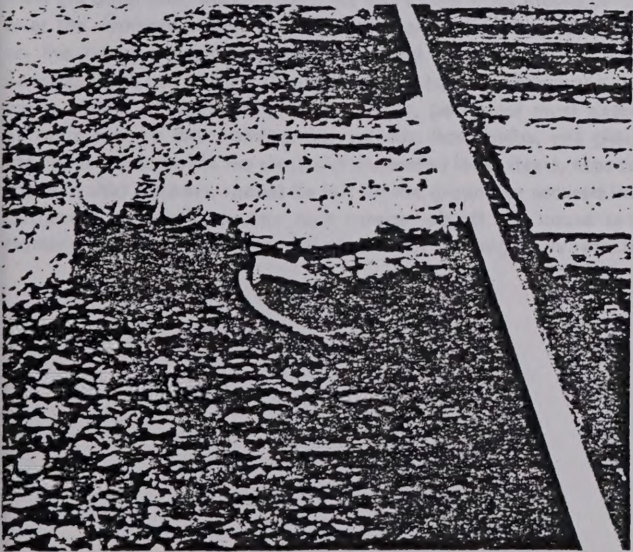


Fig. 80. Flange lubricator.

Although it is uncommon, railroad rolling stock has been known to be set afire by both exhaust and brake shoe sparks. With exhaust it is usually a matter of the sparks landing in cargo or fabric cargo covers on cars near the head of the train. Such cars should be placed at least five cars behind the power units. Brake shoe ignition most often occurs in the wooden decking of box and flat cars. This can be protected against by installing metal flashing under the deck in the area above the wheel trucks.

Flange lubricators are not really a fire problem at all, but some people who see such a large quantity of oil and are not informed think that they must be. They are not used by all railroads and even where they are used they are confined to areas of high degrees of curvature of the tracks. The oil used has a very high viscosity and flash point, very similar to differential or gear oil.

INSPECTION PROCEDURES AND SAFETY

Railroads are industrial operations in the same sense as are logging, mining, and heavy construction operations. As such, they require inspection to ensure public protection from fire. Also as such, they are governed by many safety rules. It is important that personnel required to make the inspections comply with the safety rules to the maximum extent possible. Safety rules are designed to protect workers, not inspectors. Still, inspectors should not violate them needlessly. They should always wear hard hats and avoid slick–soled shoes. Often they should wear gloves and safety glasses or goggles.

This chapter will discuss various types of inspections, procedures, safety rules, reporting procedures, legal actions which may result from inspections and methods of identifying items inspected.

MECHANICAL INSPECTIONS

Most mechanical inspections will be of either exhaust systems or brake systems. If the inspection involves the exhaust systems of maintenance or emergency equipment, the procedures and safety rules are essentially the same as for similar equipment in any other industrial or farming operation.

Exhaust Systems

When the exhaust system of a locomotive is to be inspected, the engine should always be shut down. If one or more engines of a consist are to be inspected, only one engine at a time should be shut down and restarted after inspection before the next engine is shut down. The inspector should never attempt to start or stop a locomotive engine himself. Some companies prefer to have this done by a mechanic. Others want it done by the locomotive engineer.

An exhaust inspection on most turbocharged engines requires looking down the stack from the top because the condition of the eductor is of prime importance. This means climbing on top of the locomotive. Safety rules do not permit company personnel, except certain supervisors and mechanics, to do this. There is good reason for these rules. The inspector, therefore, should proceed with caution. Most locomotives are fitted with iron climbing rods at each end. No other means of access to the top should be used. On most engines going up the cab end will result in encountering the fewest obstructions once on top, but climbing and descending is more diffcult. If access is gained from the other end, walking from the end to the stack should be done over the dynamic brake and engine water cooling fans rather than on the narrow ledge between them and the side of the engine housing. Each fan grating should be tested to determine that it is not loose. When in the vicinity of the stack, personnel must exercise extreme care so that nothing, eg., pencils, flash bulbs, eye glasses, etc., is dropped inside the stack. All unneeded loose items, especially those in shirt pockets, should be left on the ground or secured inside buttoned pocket flaps. Any such foreign object can cause severe damage to the turbocharger blades when the engine is restarted.

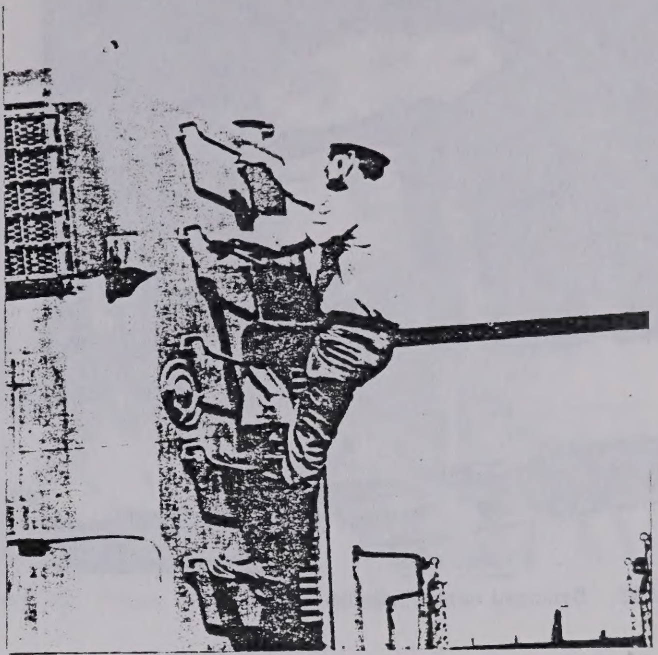


Fig. 81. Climbing on top of locomotive.

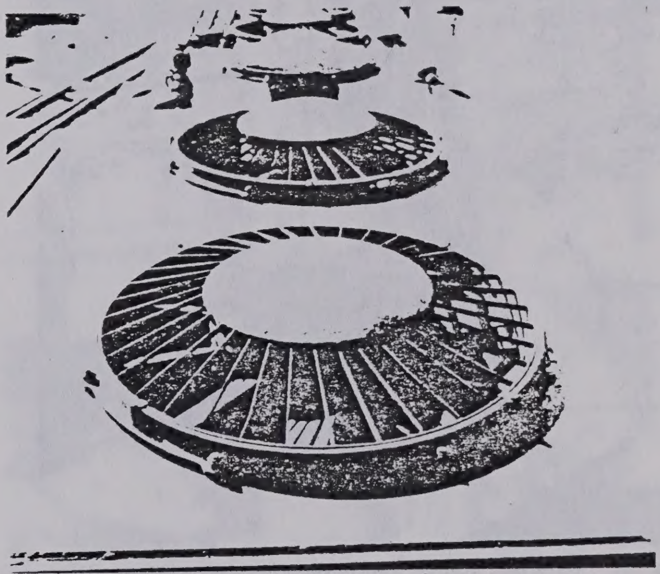


Fig. 82. Fan gratings on locomotive roof.

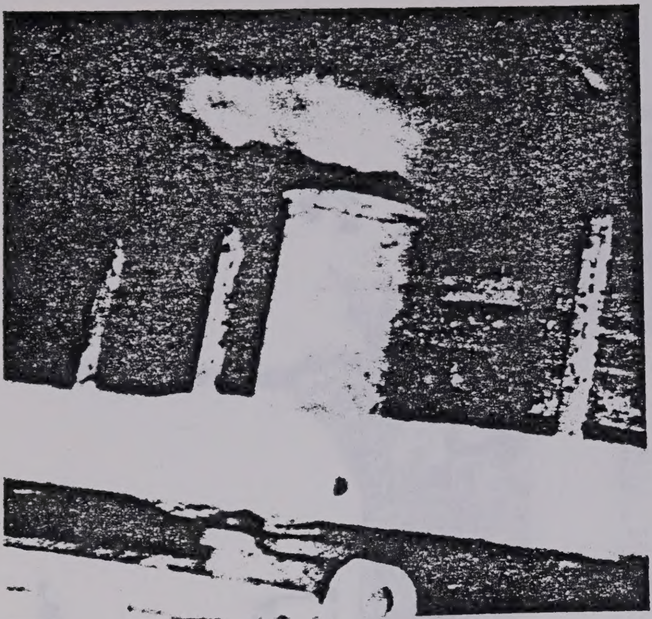


Fig. 83. Damaged turbine impeller.

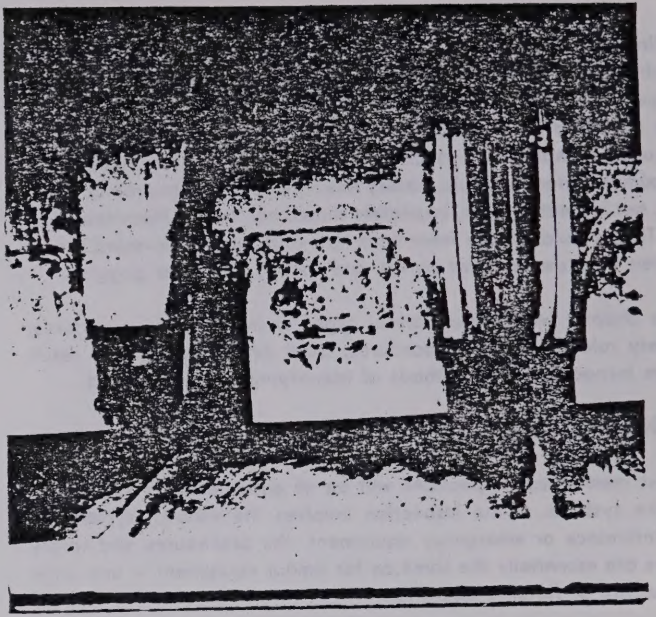


Fig. 84. Carbon trap.

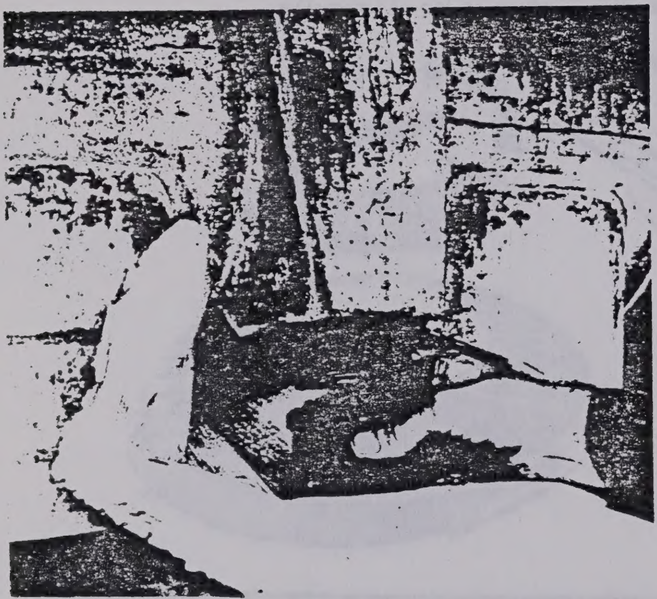


Fig. 85. Retrieving carbon from trap.

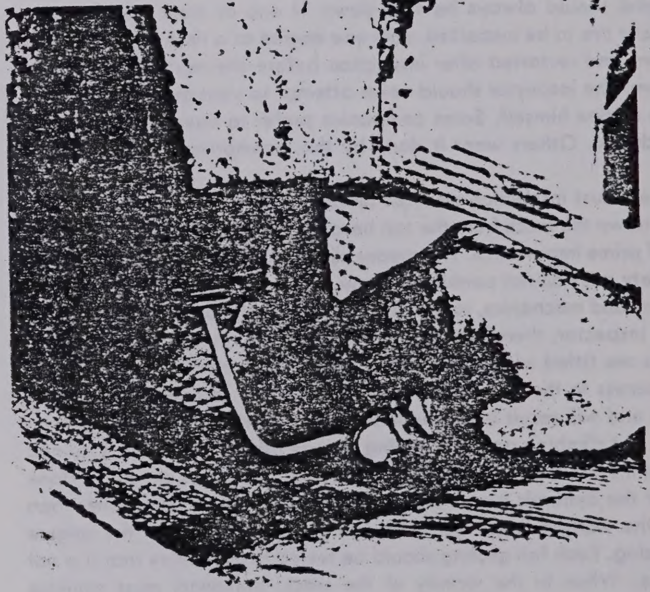


Fig. 86. Loosening carbon with bent rod.

Most normally aspirated locomotives are now fitted with retention spark arresters. Although the inspector may have reason to want to inspect the top of the stack, in which case most of the above paragraph applies, the basic inspection of this type of locomotive is done from the catwalk on the side of the engine. The side doors are opened to gain access to the caps on the carbon traps. Having been just shut down, these traps, the arrester and the exhaust manifold will be very hot. The inspector should wear gloves. Retention trap caps should be removed and replaced by a company employee. The trap caps will often require a tap from a hammer or wrench to start them to unscrew. Before removing the caps, one at a time, provision should be made for catching any carbon that may be inside. This may be done with a coffee can or a piece of cardboard. After removing each cap, caked carbon should be freed from inside. This may be done by tapping the trap with a hammer or by probing inside with a bent metal rod. After emptying the trap, the cap should be replaced snuggly, but not excessively tight, and the vibration lock engaged.

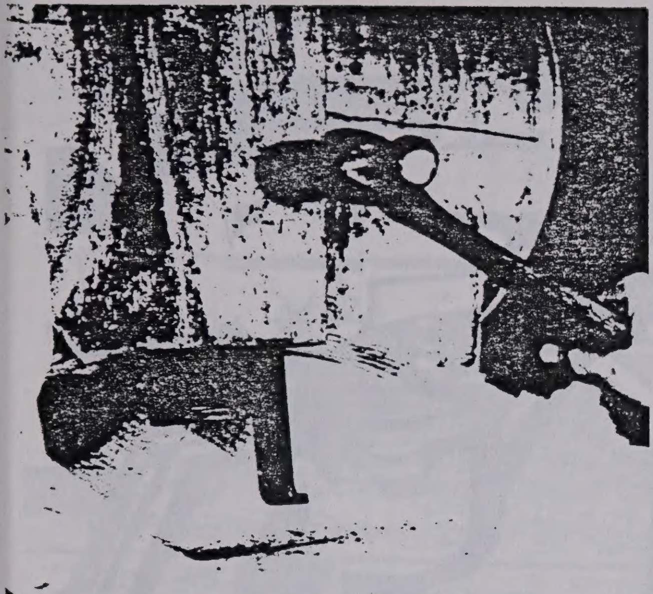


Fig. 87. Loosening carbon with hammer.

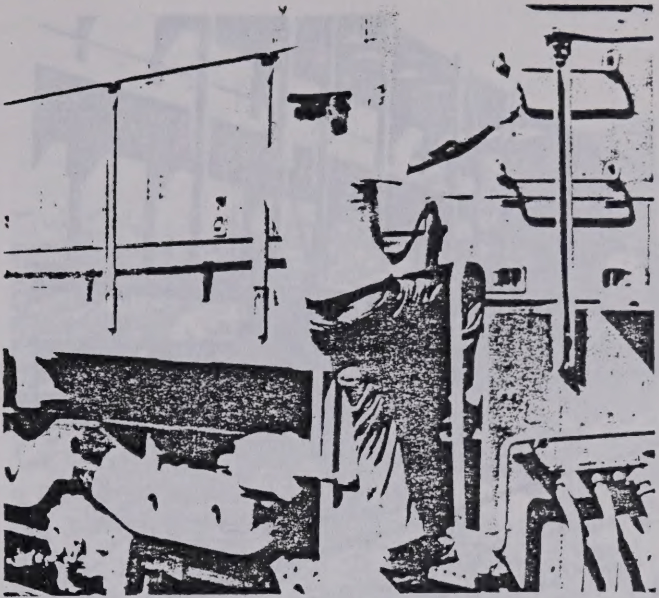


Fig. 88. Proper ascent or descent (right).

Whenever climbing up onto or down from a locomotive the inspector should always face the engine and keep a firm grip on the handrails or climbing bars with both hands. Never descend from any railroad rolling stock facing away from it.

Air Brake Systems

Air brake inspections are of three types. The first is the FRA required safety inspection which was briefly described in Chapter III, Section A. It is done by company employees. The other two are the roll–by and an isolation verification. The roll–by may be done by either company or agency personnel. The isolation verification will be conducted by a fire agency inspector, usually after a fire has occurred and a train has been stopped.

A roll–by brake inspection is made while the train is moving, preferably at a slow or moderate speed. It is a visual inspection to determine whether or not there are dragging brake shoes, extended brake cylinder pistons, loose or hanging rigging, etc. This kind of inspection cannot be effectively accomplished by one person. The brake cylinders will never all be on the same side of the train and it is usually difficult to see the shoes on the far side well enough. Therefore, one or more inspectors should be on each side of the train. Inspectors should not stand too close to the train for two reasons. The first is safety. Loose or protruding items are much more dangerous close to the train. The second is efficiency. It is much easier to observe a moving object if it is not too close. A practical distance from the near rail for a roll–by brake inspection would be 15 to 20 feet.

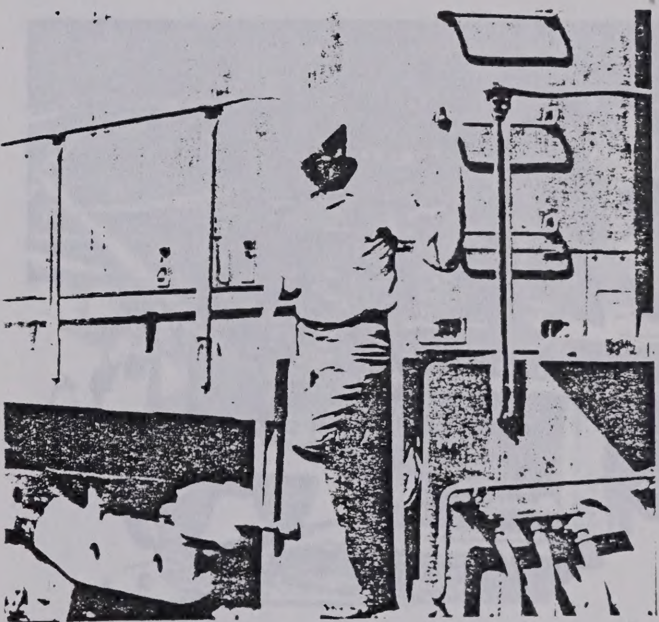


Fig. 89. Improper descent (wrong).

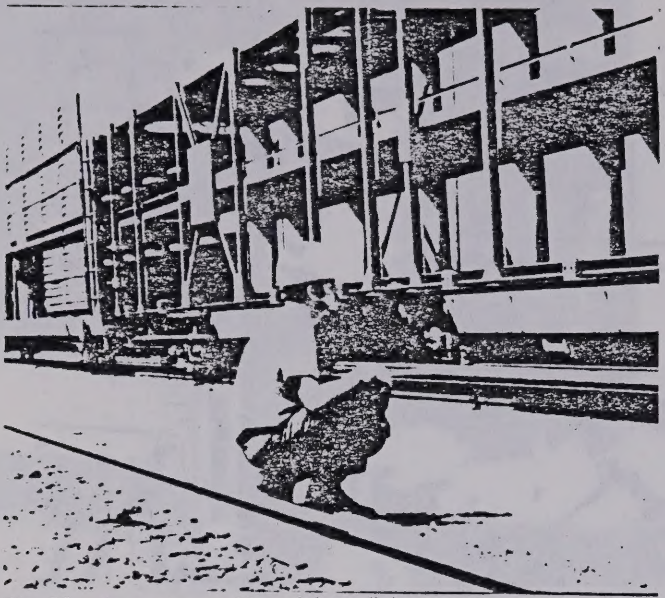


Fig. 90. Inspector positioned for roll–by.

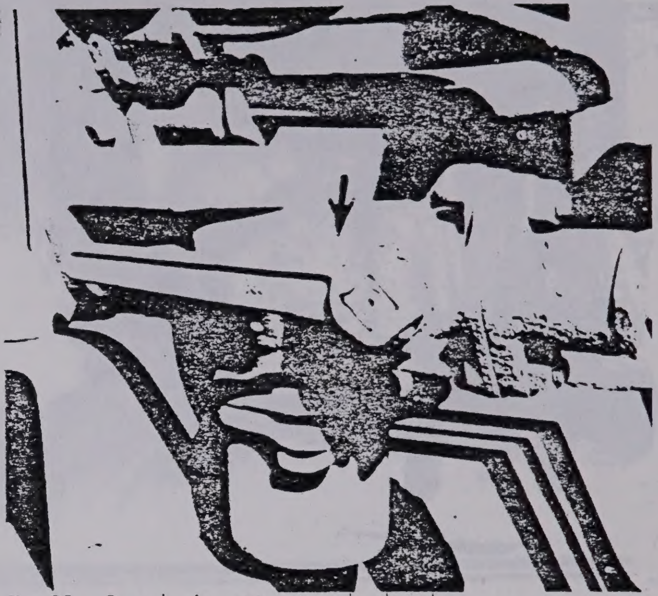


Fig. 92. Branch pipe cut–out cock, closed.

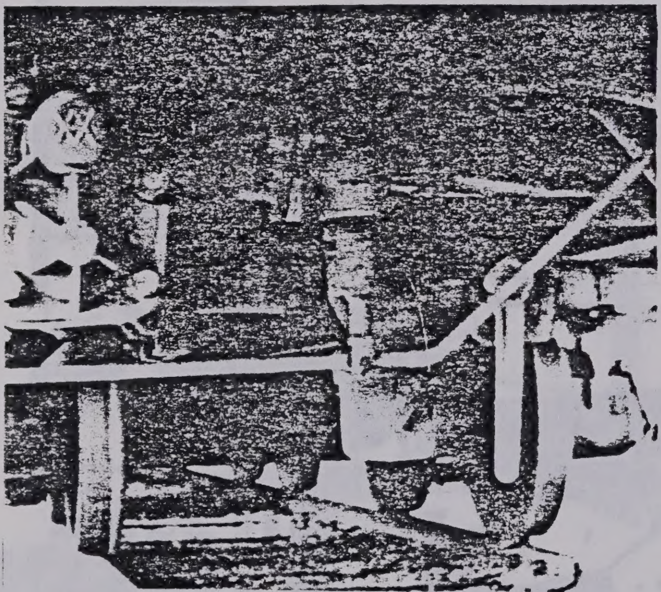


Fig. 91. Branch pipe cut–out cock, open (normal).

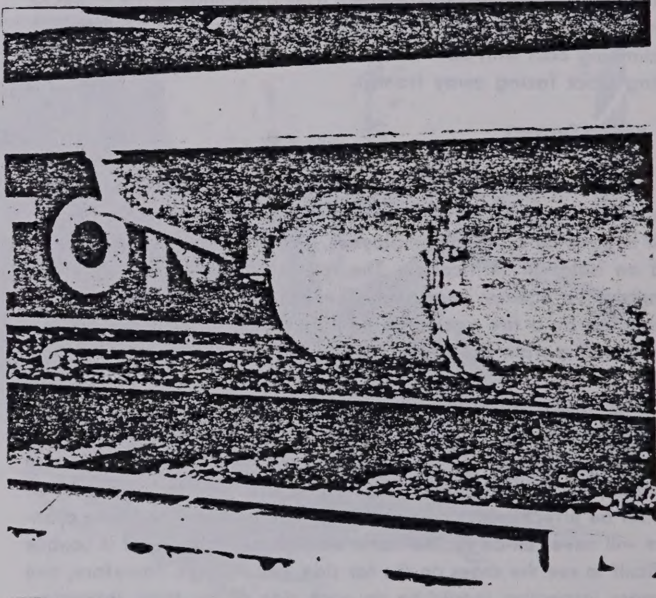


Fig. 93. Release rod and air reservoir.

During roll–bys or other inspections of rolling stock, inspectors should be alert for conditions which, though not immediate fire risks, are indicators that fire or other problems are imminent. Such things as cracked or chipped wheels, flat wheels (usually heard as thumping sounds), built–up wheel shavings, dragging equipment, etc., should be noted and reported to the company as soon as possible.

An inspection to verify that a car or cars with defective air brakes has been isolated from the brake pipe requires that the inspector know how this is done and what things should look like after it is done. The actual isolation will be done by a company employee, normally a brakeman, either in the presence of the inspector or before the inspector arrives. The inspector must satisfy himself that the branch pipe cut–out cock is closed, the air is released from the brake cylinder and the brake shoes are not dragging on the wheels. All this, except the position of the branch pipe cut–out cock handle, can be done without getting under the car. The inspector should get no further under the car than is absolutely necessary to observe the cut–out cock and should stay as short a time as possible. If he finds that he is on the wrong side of the car, or needs to observe both sides, he should go around the end of the train or over a car fitted with climbing rods, never between cars.

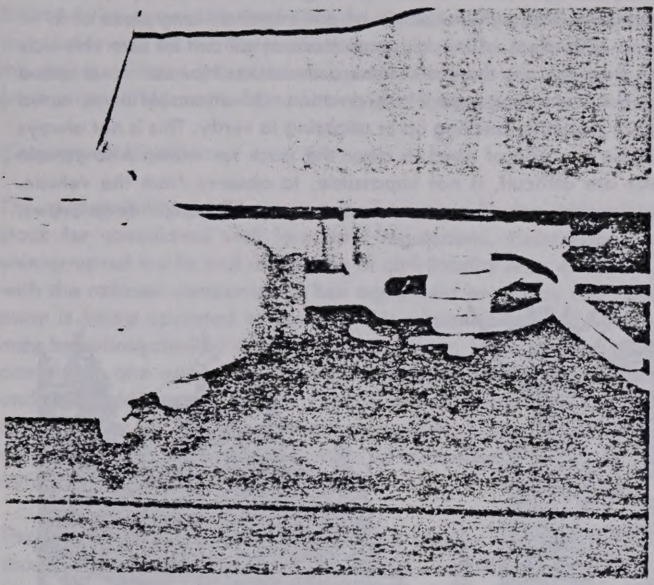


Fig. 94. Brake cylinder piston retracted (brakes released).

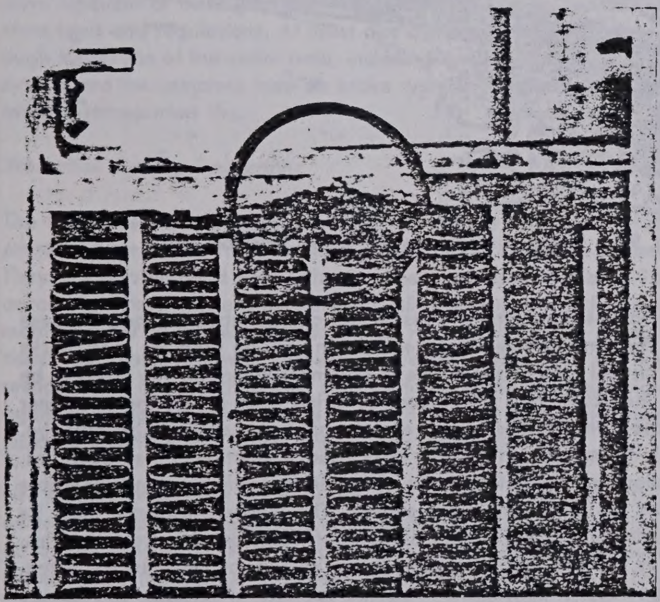


Fig. 95. Blown dynamic brake grid from GE locomotive.

Dynamic Brake Systems

Dynamic brakes cannot be effectively inspected in the sense that exhaust systems and air brakes can. The locomotive engineer has certain tests that he can make in the yard (see Chapter III, Section B). About all that the fire agency inspector can do is to listen for the whine of the grid cooling fans while the train is in motion or ask questions of the engineer when the train is stopped. On rare occasions he may be called upon to inspect a set of blown out grids. These are easy to identify from the distorted metal projecting through the protective grating. In any case, agency personnel should remember that dynamic brakes operate at 600 volts and are very dangerous to get close to.

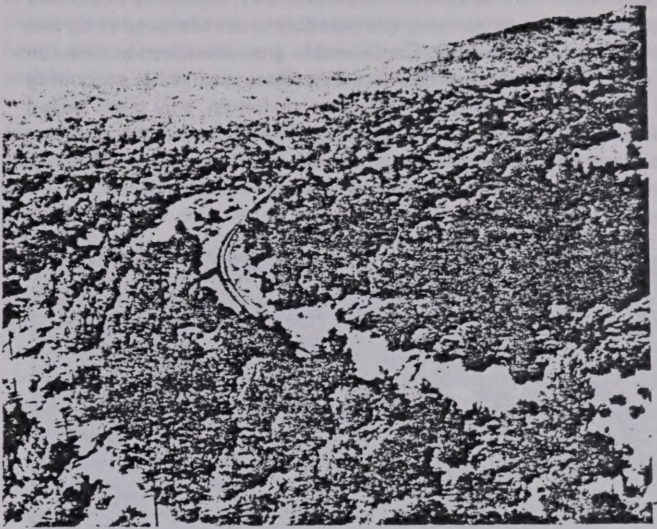


Fig. 96. Aerial photo of railroad R/W.

Fig. 97. Cut bank from speeder.

RIGHT-OF-WAY INSPECTIONS

Fire prevention inspections of rights-of-way are made to determine the nature and extent of fire hazards present and the effectiveness of measures taken to abate them. This, of course, requires an understanding of what constitutes a fire hazard and what it takes to eliminate it. Depending on the purpose of the inspection and the time available, such inspections may be made from the air, from a speeder or hyrailer or by foot.

Aerial inspection, either from helicopter or from light fixed wing aircraft, is the quickest way to make a general survey of conditions over a large segment of right–of–way (100 miles or more). On–the–ground details cannot be identified in this way, especially under tree canopies. On the other hand, questionable areas can be spotted and noted for ground checking. Considerable ground inspection time can be saved by an advance aerial survey. Since most R/W's requiring this type of inspection are in mountainous terrain, only pilots skilled in this type of flying should be used. The pilot and the observer should participate in a thorough advance briefing so that neither will have his attention distracted unnecessarily while in the air.

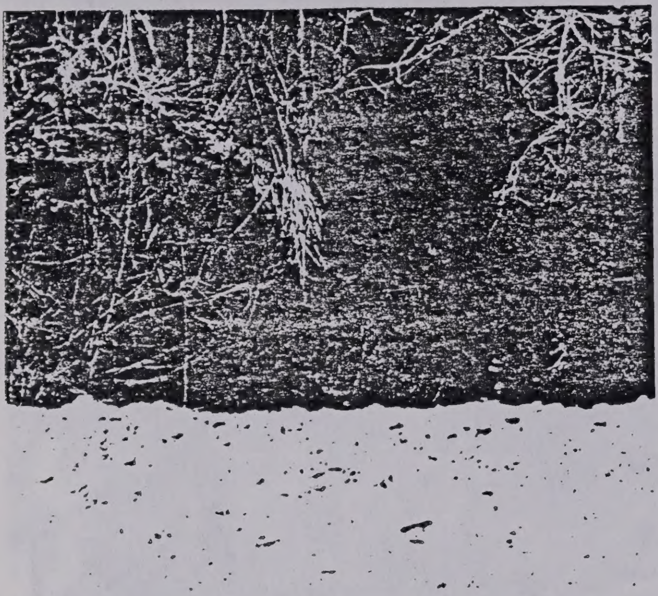


Fig. 98. Deep draw from speeder.

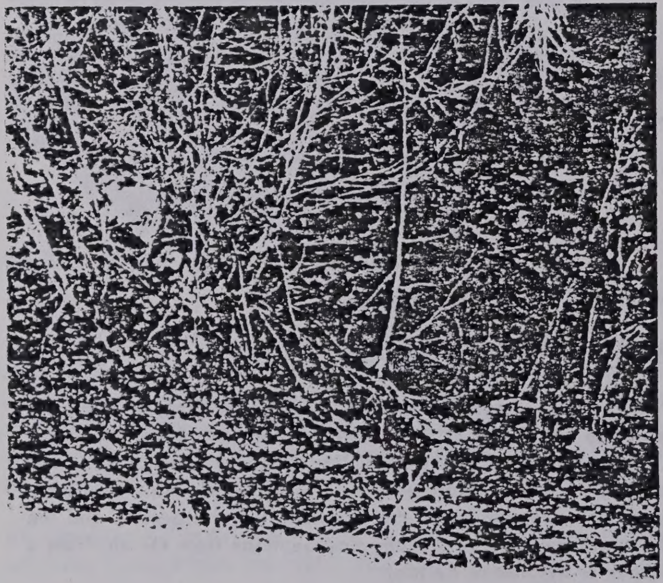


Fig. 100. Same deep draw as in Fig. 98 from on foot.

A much more comprehensive R/W inspection can be made from a speeder or hyrailer. This method is good for relatively quick and reasonably thorough inspection of a moderately long piece of R/W (25 to 100 miles). Although much more detail can be seen this way than from the air, there are some drawbacks. Normal travel speed requires a scanning type of observation. Questionable items noted require stopping, backing up or alighting to verify. This is not always possible because of need to clear the track for trains. Also certain areas are difficult, if not impossible, to observe from the vehicle. These would include high cut banks, steep fill banks, deep draws, etc.

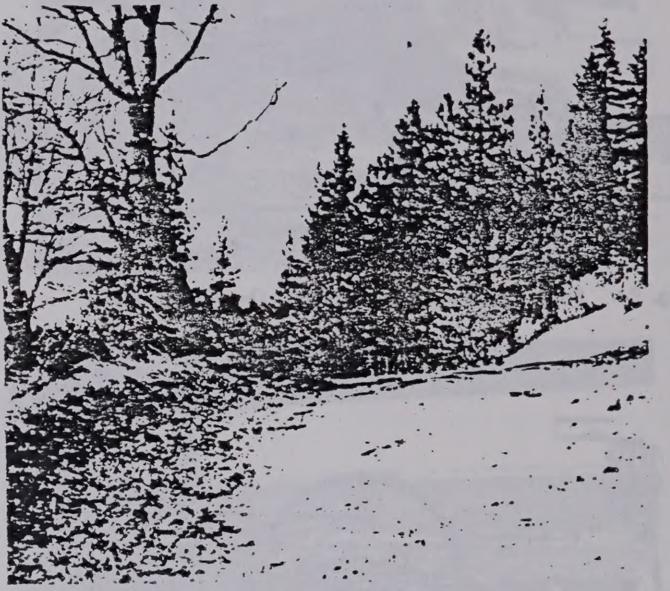


Fig. 99. Same cut bank as in Fig. 97 from on foot.

By far the most intensive inspection can be made on foot. Because of the time involved this method can only be used for spot checks of critical areas, usually one to five miles in length. The areas to be so inspected may have been identified from one of the two other inspection methods, from fire spot maps or because of a specific fire. This method allows not only close visual inspection of the tracks, ties, ballast and towpath but also of conditions farther out and not visible from the air or the track vehicle. The walking inspector must be particularly alert for the approach of trains or other track vehicles. They are not always as easy to see or hear as might be expected, especially in canyons or from the far side of tunnels. One should never enter a tunnel or start across a trestle without assuring himself that he can get safely to one end or the other before being trapped by a train.

INSPECTION RESPONSIBILITIES

Railroad fire prevention inspections are made by both the railroad companies and by the fire protection agencies. The reasons for and the timing of these inspections may differ but advantages to both parties can often come from making joint inspections.

Company Inspections

The responsibility for inspecting their rights–of–way and rolling stock for compliance with laws and regulations, maintenance of uninterrupted traffic and avoidance of civil liability rests exclusively with the railroad companies. When equipment owned by one company is being operated by another this responsibility and liability may be subrogated by contract or agreement. The operating company is the one with which the protection agency will normally deal and will hold responsible for compliance with the law. It is the responsibility of the management personnel of each company to determine how, when and by whom its inspections will be carried out.

There is no pat answer to the question of how often inspections should be made because there are several variables. Each company must determine its own appropriate inspection schedules which will probably vary between divisions, at least for R/W inspections. Some company rules establish inspection schedules and procedures either more frequent or more intensive than those required by federal or state laws and regulations. At least one company conducts a thorough inspection of the entire train, including the locomotive exhaust system and the complete train air brake system, as soon as possible after each reported fire.

Protection Agency Inspections

The fire protection agencies are charged with the responsibility of protecting the public from loss of life, property and resources by fire. They are also charged with enforcing the forest and fire laws. To accomplish these missions they inspect railroad property and equipment in order to prevent wildland fires. Protection agency inspections do not, however, relieve railroad companies of the responsibility of inspecting their own facilities. Public fire protection agencies do have a duty to make known to railroad companies those violations and defects noted during their inspections.

Fire agency inspections are generally of two types: routine and fire emergency. Routine inspections will usually be general surveys (by air or rail vehicle) of R/W's, or roll–bys of air brakes or exhaust system inspections either at division points or in service areas. The inspector will make every effort to interfere as little as possible with train operations. These may be original inspections or compliance checks following prior notification of violations.

Fire emergency inspections include point of origin and ignition source determination as well as identification of the specific locomotive or car that provided the ignition source. Both types of investigation commonly occur simultaneously, thus requiring the assignment of several inspectors at different locations. The suspected offending train must be identified and stopped. This requires quick and efficient communications between the fire dispatchers and train dispatchers. Unless an unusually dangerous fire situation exists, the train should not be stopped on the main line but should be put into the next available siding where it should be held until the inspection is completed. In any event, it should not be stopped where grade crossings will be blocked. The nearest trained and qualified inspector(s) should be dispatched to the train and the company requested to send the trainmaster. The inspector should make his inspections thorough but expeditious and should release the train as soon as he has collected evidence and statements and is satisfied that the problem has either been corrected or isolated.

Most fire agency inspections can be adequately conducted by visual inspection. Inspectors should be equipped with such aids as tape measures, notebooks and cameras. For fire cause investigations they should also have magnifying glasses and magnets. All major violations should be recorded in the field notebook and photographed.

The results of any fire agency inspection should be properly recorded. Each agency has its own forms and procedures for this purpose. Fire–cause investigations will usually be recorded on special forms. Other types of inspections may be recorded on forms, memos, formal letters, etc. One useful form used by the California Department of Forestry and the U.S. Forest Service and available to other agencies is the Inspection Report (LE–38 or R5–5100–209). Regardless of the format of the report, a copy should be sent or given to the railroad company. Reports should be specific enough for the company to act on them and for the courts to relate them to complaints or other legal actions in the event such actions are filed. They are not to serve as work lists for the company.

Protection agency personnel often have occasion to observe conditions on railroad rolling stock, and to a lesser extent on R/W's, that are not violations of fire laws or regulations but which may be dangerous or a violation over which they have no jurisdiction. These should be reported to the company verbally as soon as possible. If they have contributed to a fire, or are likely to, they should also be recorded in writing and photographed.

Joint Inspections

Joint inspections are for the purpose of acquainting both fire protection agency and railroad personnel with violations and other problems and conditions. They often result in mutual agreement on methods of correction of problems. Joint inspections are not always possible because of time commitments or company or agency policy. They are, however, encouraged to the extent feasible as they provide an excellent opportunity for mutual training, understanding and trust.

Because of the mechanical and physical hazards involved, inspections of locomotive exhaust systems and inspections to determine air brake isolation should always be joint. Company policies vary with regard to who should represent them. Some want a supervisor present. Others want the train crew to represent them. In any event, the agency inspector should not attempt these types of inspections alone.

LEGAL ACTIONS

Inspections or fire cause investigations may lead to any one or a combination of four different basic types of legal action. Since these actions are sometimes misunderstood and confused with each other by both agency and company personnel, each will be described briefly here.

Administrative

This is not a legal action in the sense that a court is involved. It is, however, a formal notification of violation of a law or regulation and a notice to correct the violation, usually within a specified time. It becomes a matter of record and may serve as the basis for more stringent action later. If compliance is not obtained the administrative action becomes a documented history.

Administrative action is initiated by the protection agency and addressed to the operating company. It may take any of a number of forms. The colored inspection tag for locomotives or red tag for other internal combustion engine–driven equipment is affixed to the machine itself and is both a notice of violation and an order to shut down or isolate the engine and not place it back in service till the violation is corrected. The "Inspection Report" (LE–38 or R5–5100–209) is a notification of the findings of an inspection. The uninitiated sometimes confuse it with a citation, which it is not.

Administrative action may also come in the form of a letter, memo, telegram, etc., from the inspector or his supervisor. Letters of demand for damages or costs of suppression fall in this category.

Civil

This is a filing, with a court of appropriate jurisdiction, of a suit for damages or costs of fire suppression or both. It is seldom filed unless a letter of demand has been ignored or denied.

Criminal

Criminal action is usually initiated by a citation or a complaint. Most criminal actions coming from violations of fire laws or regulations are misdemeanor actions. Such actions may name either the company or the employee who was found committing the act, or both, as the defendant. If the company is named, the only penalty possible is a fine. If an employee is named, the penalty may be either a fine or a jail term or both.

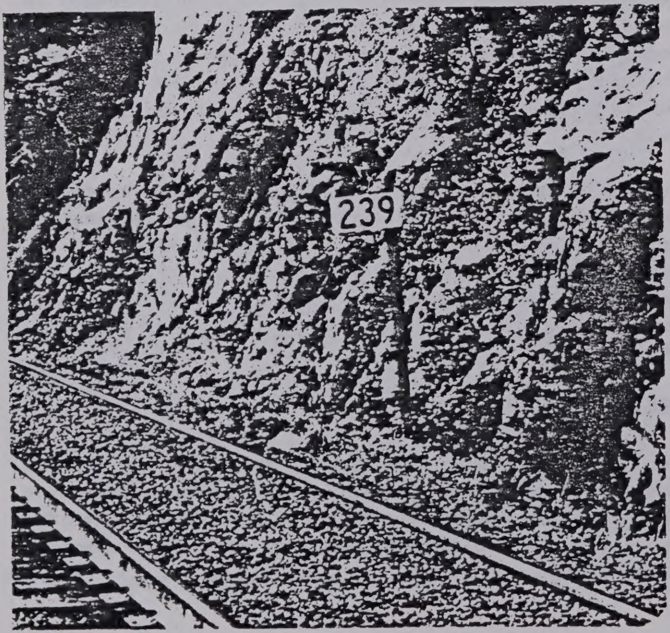


Fig. 101. Mile post.

Equity

An equity action is one seeking a court order requiring the defendant to refrain from doing some specific act that is harmful to the plaintiff or to the public at large or to do something to avoid such damage. This is commonly known as an injunction.

IDENTIFICATION OF ITEM INSPECTED

Fire protection agencies have their own systems of identifying locations, usually by section, township and range. They have no specific system of identifying railroad rolling stock. Agency location systems, including place names, generally have no meaning to or are confusing to railroad people. It is therefore best for all concerned if the agency personnel will identify items and occurrences by the railroad systems' terminology. There are basically two of these: location and rolling stock.

Location

Locations on railroad rights–of–way are best identified by use of the mile post number. These numbers are indicated on special signs at one mile intervals along all common carrier railroad R/W's. More precise locations between the mile posts are given on different railroads by either pole number, decimal or fraction of a mile. Pole number refers to the telephone poles that parallel most tracks. They are indicated in writing with the MP number followed by a slant (/) followed in turn by the pole number (eg., 237/20: The 20th pole beyond MP 237). Decimals and fractions are self–explanatory and are indicated by their usual mathematical symbols. Agency inspectors should only use the type of inter–mile post designation used by the particular railroad company being inspected.

Certain special locations can be identified by their names or numbers. These include tunnels, snowsheds, bridges, trestles, etc. Most all of these have numbers (eg., Tunnel 17). The longer or more unique ones are often named (eg., West Branch Bridge). A properly specific location will also designate which end is being referred to. For this purpose the end nearest to San Francisco is always "west" to railroad personnel, even if it is north or east geographically.

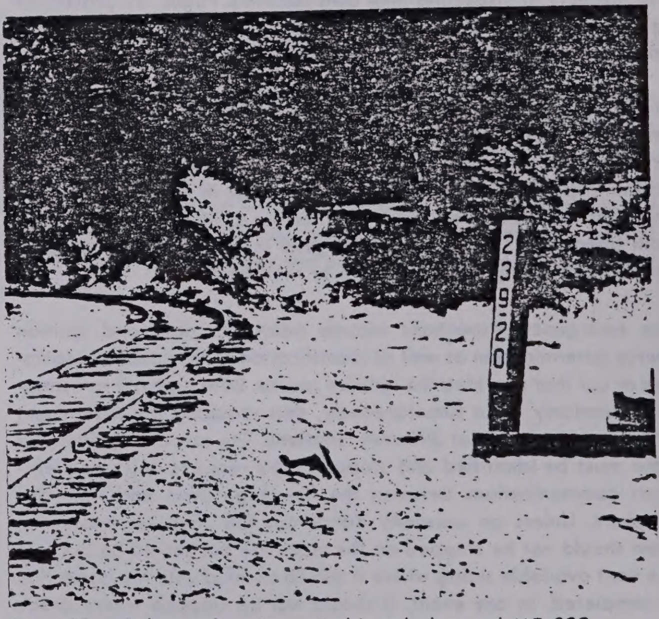


Fig. 102. Pole number (twentieth) pole beyond MP 239.

Place names can be confusing to railroad and protection agency personnel alike if care is not exercised in their use. To railroad people, place names refer to sidings, yards and stations. If the agency people are actually referring to powerhouses, fire stations, campgrounds or something else, there is no effective communication. In referring to sidings it is helpful to indicate "east" or "west" switch since many of these sidings are from one to two miles long.

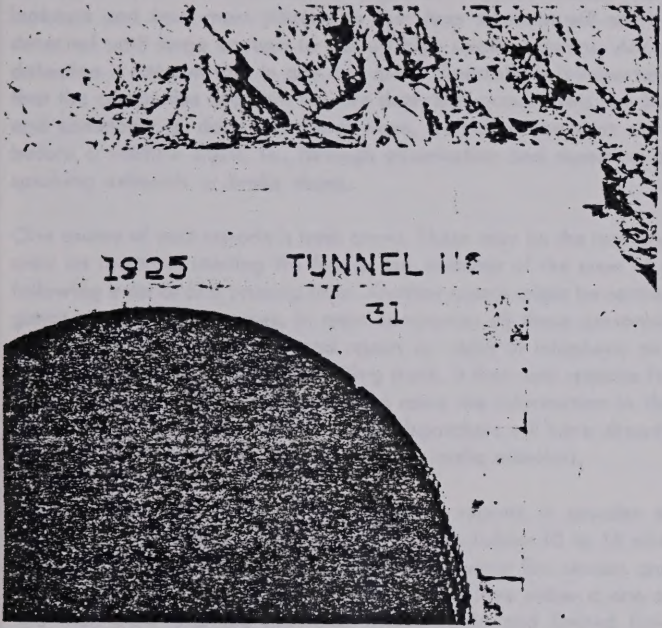


Fig. 103. Tunnel portal showing number.

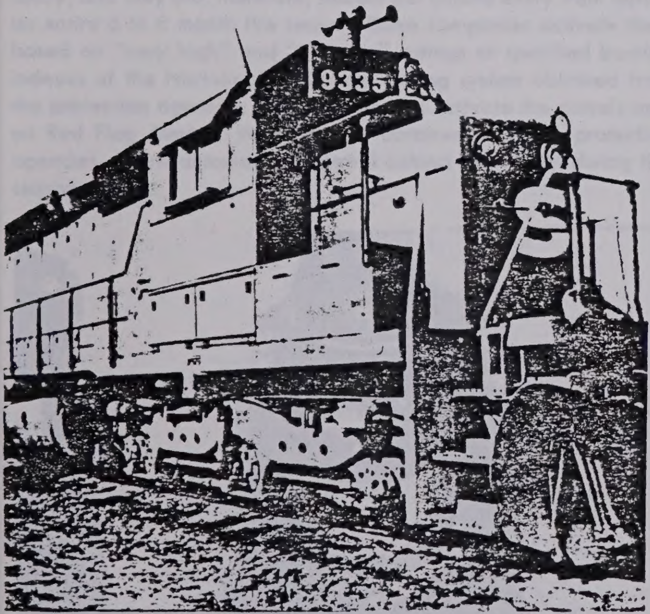


Fig. 104. Locomotive number.

Rolling stock

Trains can usually be identified by a number or a combination of letters and numbers but protection agency personnel are seldom conversant with this system. Still, they can be quite positively identified by either the lead engine number or caboose number or both. The time and location seen and the direction of travel (in railroad terminology) should also be given.

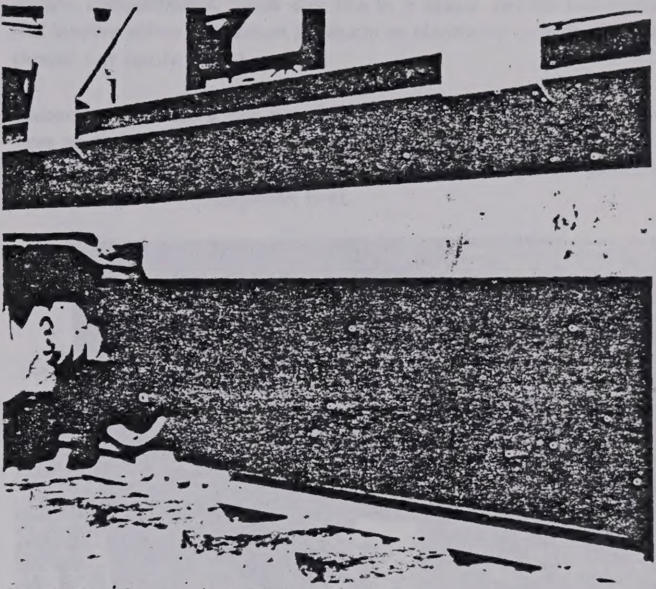


Fig. 105. Car number (auto car).

Individual locomotives and cars should be identified by number. Additional identifying information is helpful. This might include make and home road of an engine or home road and type (box, flat, gondola, hopper, etc.) of car.

FIRE DETECTION AND SUPPRESSION

When all prevention efforts and activities fail, fires occur. Then the task at hand becomes that of keeping the losses to a minimum. Responsibility for this rests jointly with the railroad companies and the fire protection agencies. It involves quick detection and reporting of fire starts and fast and effective suppression activity.

Fire protection agencies have detection systems including fixed lookouts and aerial patrols. They also rely on citizen reports. Unfortunately, many portions of railroad right–of–way are hidden from lookouts and from most citizens so that fires on them will not be detected until large enough to put up high smoke columns. Aerial detection is not constant in any one area. Therefore, it is important that the companies augment the fire detection system. This can be, and commonly is, done in several ways. Detection can start even before a wildfire starts, ie., through observation and reporting of sparking exhausts or brake shoes.

One source of such reports is train crews. These may be the rear end crew on the train starting the fire or any member of the crew of a following train or of a passing train. Another source might be section gangs or other work crews. In most companies all these personnel are under orders to observe and report by radio or telephone any abnormal occurrence related to rolling stock. It then only remains for the company dispatchers or agents to relay the information to the fire dispatchers. In some cases the fire dispatchers will have already intercepted the message on their scanner radio monitors.

Another source of company fire detection reports is speeder or hydrailer patrols. These are normally timed to follow 10 to 15 minutes behind trains. They are only activated during fire season and usually only during daylight hours. They may have either a one or two man crew and are provided with a radio and limited firefighting tools. Unless they discover a fire while it is still very small they will usually need help in suppressing it. Such patrols are quite costly, and they are, therefore, seldom put behind every train during an entire 6 to 8 month fire season. Some companies activate them based on "very high" and "extreme" ratings or specified burning indexes of the National Fire Danger Rating system obtained from the protection agencies. Other companies activate the patrols only on Red Flag Alert or Warning also obtained from the protection agencies. A few automatically patrol behind every train during fire season.

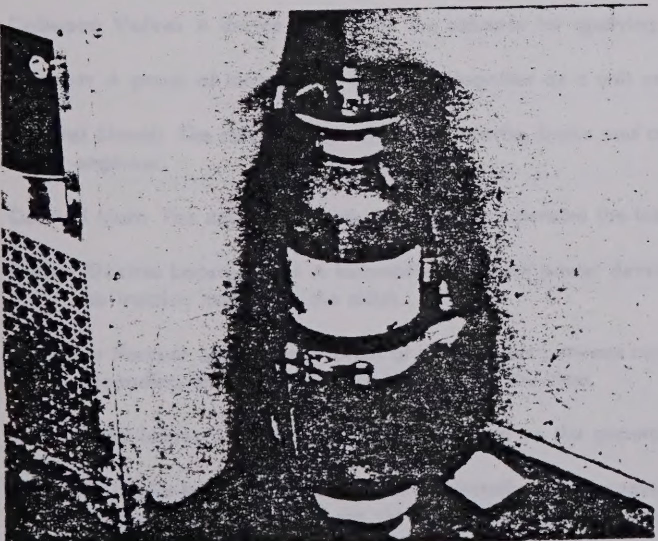


Fig. 106. Fire extinguisher on locomotive.

When fires do occur on railroad property or R/W's, the company has a legal responsibility to report them to the protection agency and to do all in its power to suppress the fire. If the fire involves rolling stock, the company also has the duty to inform firemen of the nature of the cargo involved in or exposed to the fire. The most positive source of this information is the conductor's bills of lading.

Certain firefighting equipment is required, and normally present, on railroad equipment and work locations. Each locomotive is equipped with a dry powder fire extinguisher mounted in the cab or in the engine compartment. Since any fire in a diesel electric locomotive will involve either petroleum products or electricity or both, firemen should not apply water.

Cabooses also carry dry powder fire extinguishers for combating fires on the train. In addition, those cabooses operating regularly in California carry a five gallon back pack water extinguisher primarily for fighting R/W vegetation fires.

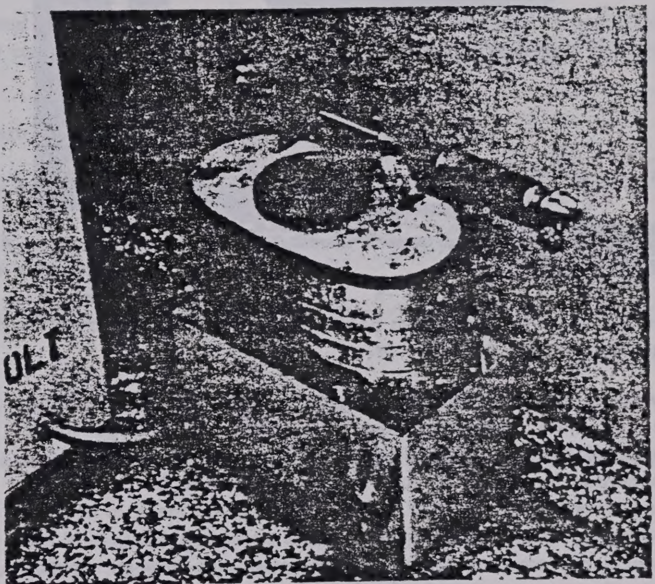


Fig. 107. Back pump on caboose.

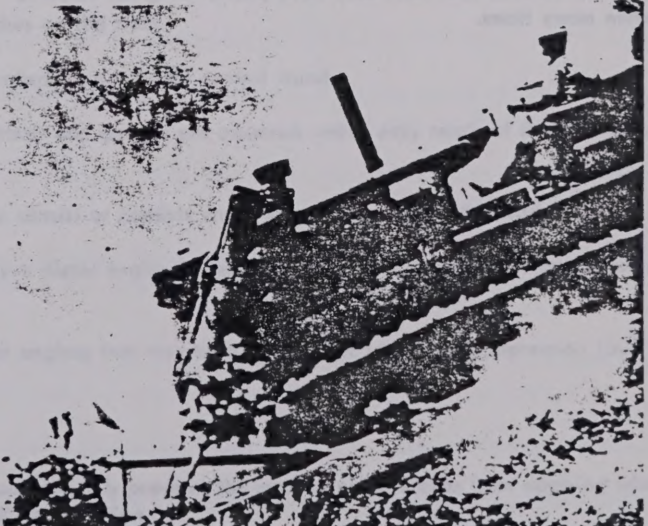


Fig. 108. Bulldozer fighting forest fire.

Section, track, bridge and other work crews are required to have, in addition to their regular work tools, firefighting tools and equipment. These must be readily available at the work site and reserved solely for firefighting purposes.

Company–owned bulldozers, and in certain areas motor graders, are excellent wildland firefighting machines. The companies should always make them available to work under the supervision of the agency fire boss on any fire.

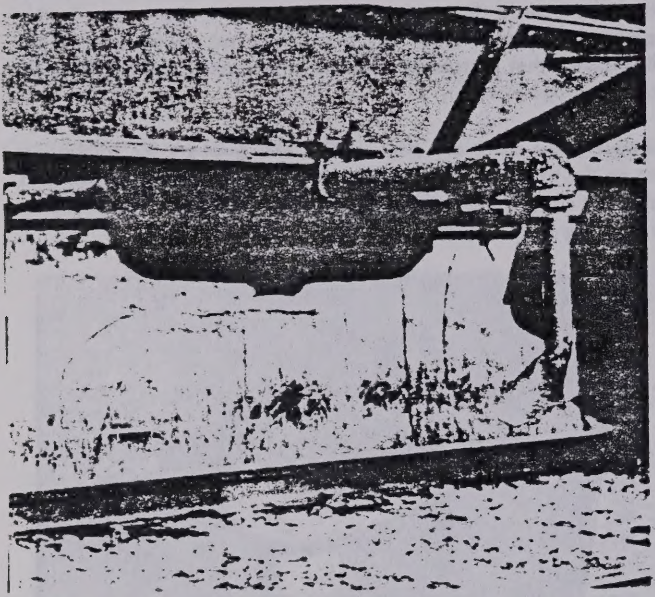


Fig. 109. Water sprinkler car.

Several railroad companies provide water tank cars exclusively for fire protection purposes during fire season. These large water sources (8000 to 12,000 gallons each) can be of great help to fire suppression forces. To be fully effective they must be capable of being moved to the scene of a fire quickly and left there, or nearby, as long as needed. This often presents some problems. It is not economically practical to have a locomotive and crew on standby where the cars are parked. Also R/W fires seldom occur at sidings, thus a tank car at the fire will usually tie up main line track. In spite of these problems, such tank cars have proven of great value to firemen many times.

It is important for fire agency personnel to check firefighting water tank cars at the beginning of each fire season to see that they are equipped with pumps, fire hose (minimum 200 feet) and nozzles. The outlets should also be checked for size and threads compatible with fire agency equipment. If found not compatible, suitable adaptors should be provided on the cars.

One company has developed a unique water car which it attaches to the rear of each train operated during fire season. This car is equipped with spray nozzles which can sprinkle the entire R/W for approximately 20 feet each side of center line. The nozzles can be activated either by the brake pipe reduction which applies the train air brakes or manually by the conductor or rear brakeman.

Effectiveness of fire detection and suppression is largely dependent on adequate communications. Between railroad companies and fire agencies these are normally accomplished by commercial telephone. Many fire agencies augment telephone communications by including railroad frequencies on the radio scanning monitors which they use to keep in touch with neighboring fire and police agencies. If the railroads were to install radio monitors on fire frequencies at certain locations and in the vehicles of certain supervisors (eg., division engineers, trainmasters, road foremen of engines) the cross–monitoring would allow direct radio communications during emergencies. Each company or agency employee would talk on his own frequency and listen on the other frequency. This would result in a considerable increase in efficiency as long as proper radio traffic discipline was observed.

Railroad companies, in addition to radio and commercial telephone, have private phone systems for internal communications. Often these can be patched in to commercial telephone, allowing fire dispatchers to talk to various company employees with only one call and the use of several extensions.

Appendix A

GLOSSARY OF TERMS

AAR: Association of American Railroads. Sets standards for size, quality and performance of rolling stock and components used in interchange service.

AB Control Valve (including ABD, ABDW, etc.): Device mounted on each car to convert changes in brake pipe pressure to application or release of brakes.

Alternator: A form of generator that produces alternating current electricity.

Ampere: Unit of electric current. One volt applied across one ohm of resistance will produce one ampere of current. Roughly analagous to gpm flow in a fire hose.

Automatic Brake Valve: The device by which the locomotive engineer controls the pressure in the brake pipe and thus the application or release of the air brakes on the train.

Auxiliary Reservoir: An air storage tank located on each locomotive and car to supply air to the brake cylinder in response to operation of the AB valve upon reduction of brake pipe pressure. On freight cars the auxiliary and emergency reservoirs are housed in the two halves of a single tank.

Ballast: The bed of rock, cinders or slag which supports the ties on which the rails are mounted.

Block Signal: A device for safely controlling the movement of trains by means of colored lights; red, green and yellow.

Brake Cylinder: A device mounted on each locomotive and car in which compressed air from the auxiliary or emergency reservoir acts on a piston which transmits the force to the brake shoes through the brake rigging.

Brake Cylinder Release Valve: A device for quickly releasing the air from a brake cylinder without affecting the rest of the brake system on the car.

Brake Head: A holder attached to or a part of the brake beam which carries the detachable brake shoe.

Brake Pipe: The system of piping extending the entire length of each locomotive and car, including hose and hose couplings, for the passage of air to control the air brakes.

Brake Shoe: A replaceable friction element secured to the brake head which is pressed against the wheel to produce retarding force. Two general types of brakes shoe friction elements are used: *Composition High Friction* and *Cast Iron Low Friction.*

Bunch Braking: A term used to describe the deceleration of a train by allowing the train to run in against the engine.

Caboose Valve: A device located on the caboose for applying air brakes on the train.

Consist: A group of locomotives operating together as a unit and controlled from a single control stand.

Control Stand: The column upon which the throttle, brake and other controls and gauges are mounted within easy reach of the locomotive engineer.

Control Unit: The unit from which the engineer operates the locomotive consist or consists under his control, usually the lead unit.

Diesel Electric Locomotive: A locomotive in which power developed by a diesel engine is delivered through a generator or alternator to the traction motors on the axles.

Drawbar Forces: Longitudinal forces at the couplers between cars and/or engines that may be either tension (draft) or compression (buff), depending on the handling of the train at the time.

Duff: Dead leaves, needles or grass accumulated on the ground.

Dynamic Brake Interlock (DBI): A device installed on an engine that automatically prevents the locomotive air brakes from applying when the automatic air brakes are set on the train during dynamic braking operation.

Dynamic Braking: An electrical means used to convert some of the power developed by the momentum of a moving engine into an effective retarding force. Electric circuits are set up which change the traction motors into generators. Since it takes power to rotate a generator this action retards the speed of the train. The energy generated by the traction motors is fed to the resistor grids and dissipated as heat.

Emergency Application: A rapid, heavy exhausting of air from the brake pipe which results in maximum brake shoe pressure on the wheels of all cars and locomotives.

Emerency Reservoir: An air storage tank located on each car to supply air (in addition to that from the auxiliary reservoir) to the brake cylinder in response to operation of the AB valve upon emergency application. On freight cars the auxiliary and emergency reservoirs are housed in the two halves of a single tank.

Engine: Often used interchangeably with "locomotive." Properly refers only to the diesel or steam primary source of mechanical energy.

Federal Railroad Administration (FRA): An agency of the U.S. Department of Transportation charged with overseeing and regulating matters relating to rail transportation and safety. Assumed most of the responsibilities of the Interstate Commerce Commission (ICC) insofar as railroads are concerned.

Fire Hazard: The flammable materials that may be ignited by the various fire risks.

Fire Risk: A source of ignition of fire hazards.

Flange Lubricator: A track mounted device, used in areas of high curvature, to apply grease or oil to wheel flanges as they pass by to reduce track and flange wear.

Generator: A machine for converting rotational mechanical energy into electrical energy. The term applies to either the main generator of a locomotive when operating under motive power or to the traction motors when operating on dynamic brakes.

Grid: An electrical resistor capable of dissipating quantities of electrical energy as heat.

Helper: A manned locomotive, usually placed toward the rear of a train, to assist in the movement of the train.

Hot Box Detector: A trackside device that monitors the axle bearing temperatures of a passing train to detect incipient journal failures and thus prevent derailments.

Independent Brake Valve: A valve that provides control of the locomotive air brakes regardless of the automatic brake valve handle position.

Main Reservoir: An air tank on the locomotive for storing and cooling compressed air.

Motor: A machine for converting electrical energy into mechanical energy.

Ohm: Unit of resistance to flow of electric current. One ohm of resistance requires one volt of energy to push one ampere of current across it. Roughly analogous to friction loss in a fire hose.

RCE–1 Unit: A locomotive or consist separated from the lead consist and remotely controlled from the control unit.

Reduction (of the brake pipe): A decrease in brake pipe pressure at a rate and of an amount sufficient to cause a train brake application to be initiated or increased.

Release Rod: A small rod situated at the side sill of a car for the purpose of releasing the air brakes on that car by activating the brake cylinder release valve.

Retaining Valve (Retainer): A spring–loaded check valve or a restricting exhaust choke in series with the brake cylinder exhaust located on each car which, when turned to an operating position, will maintain a retarding force on car brakes on a descending grade while the brake pipe is being recharged.

Right–of–Way· The strip of land of varying width on which the tracks and other operating installations are placed and over which the operating company has some degree of control, by either deed, easement or special use permit.

Running Release: Release of automatic brake service application while the train is in motion.

Service Application: Exhausting the brake pipe at a service (normal, not emergency) rate to apply the train brakes.

Service Rate: The rate, slower than emergency, at which the brake pipe pressure is reduced by the engineer using the automatic brake valve to cause the control valve at each car to vent air from the auxiliary reservoir to the brake cylinder.

Siding: A section of track parallel to the main line track, with track switches at each end, on which a train or other rolling stock may be placed in order to open the main line for passage of traffic.

Slash: Severed limbs and tops remaining after felling or pruning trees or brush.

Split Reduction: A brake pipe reduction less than the fully desired reduction followed by further light reductions until the desired total reduction is reached. Makes for a smooth slowdown or stop.

Stretch Braking: The deceleration of a train by application of the automatic brake while the locomotive is still working in reduced power.

Towpath: A narrow strip of the right–of–way adjacent to each side of the ballast which is normally kept clean enough for personnel to walk on.

Traction Motor: A device that converts electrical energy into mechanical energy which turns the locomotive wheels. It is mounted directly on each driving axle between the wheels of an engine truck.

Truck: The system of frame, springs, plate, journals, wheels and axles which supports one end of a car or locomotive. Freight car trucks have two axles. Passenger car and locomotive trucks may have two or three axles.

Volt: Unit of electric energy force. One volt is required to push one ampere of current across one ohm of resistance. Roughly analogous to psi of pressure in a fire hose.

Watt: Unit of electric power equal to a current flow of one ampere under one volt of pressure; 746 watts equal one horsepower; 1000 watts equal 1 kilowatt.

Appendix B

STATUTES AND REGULATIONS

There are several hundred laws and regulations applicable to railroad operations. Many of these are very long. Some treat several subjects. Most do not relate to wildland fire prevention. This appendix has been designed to present only those laws and regulations, or portions thereof, which pertain to wildland fire prevention and operational safety. As such this appendix should only be used as a quick field reference. For full text, meaning and proper context of laws and regulations reference should be made to the applicable code books.

I. FEDERAL REGULATIONS

A. WILDLAND FIRE PREVENTION TITLE 36 CODE OF FEDERAL REGULATIONS (36CFR)

Section 261.1

Scope. The prohibitions in this part apply, except as otherwise provided, when:

(a) An act or omission occurs in the National Forest System or on a Forest development road or trail.

(b) An act or omission affects, threatens, or endangers property of the United States administered by the Forest Service.

(c) An act or omission affects, threatens, or endangers a person using, or engaged in the protection, improvement or administration of the National Forest System or a Forest development road or trail.

Section 261.2

Definitions. The following definitions apply to this part:

(a) "Campfire" means a fire, not within any building, mobile home or living accommodation mounted on a motor vehicle, which is used for cooking, personal warmth, lighting, ceremonial, or esthetic purposes. "Fire" includes campfire.

(b) ....

(f) ....

(g) "Forest officer" means an employee of the Forest Service.

(h) "National Forest System" includes all national forest lands and waters reserved or withdrawn from the public domain of the United States, national forest lands and waters acquired through purchase, exchange, donation, or other means, national grasslands and land utilization projects and waters administered under Title III of the Bankhead–Jones Farm Tenant Act (50 Stat. 525, 7 U.S.C. 1010–1012), and other lands, waters, or interests therein acquired under the Wild and Scenic River Act (16 U.S.C. 1271–1287) or National Trails System Act (16 U.S.C. 1241–1249).

(i) ....

(k) ....

(l) "Permit" means authorization in writing by a forest officer.

(m) ....

(n) ....

(o) "State" means any State, the Commonwealth of Puerto Rico, and the District of Columbia.

(p) "State law" means the law of any State in whose exterior boundaries an act or omission occurs regardless of whether State law is otherwise applicable.

(q) "Stove fire" means a campfire built inside an enclosed stove or grill, a portable brazier, or a pressurized liquid or gas stove, including a space–heating device.

(r) ....

Section 261.5

Fire. The following are prohibited:

(a) Carelessly or negligently throwing or placing any burning, glowing, or ignited substance, or any other substance or thing which may cause a fire, into any place where it might start a fire.

(b) Firing any tracer bullet or incendiary ammunition.

(c) Causing timber, trees, slash, brush or grass to burn except as authorized by permit.

(d) Leaving a fire without completely extinguishing it.

(e) Allowing a fire to escape from control.

(f) Building, attending, maintaining, or using a campfire without removing all flammable material from around the campfire adequate to prevent its escape.

Section 261.50

Orders.

(a) The Chief, each Regional Forester, each Experiment Station Director, the Administrator of the Lake Tahoe Basin Management Unit and each Forest Supervisor may issue orders which close or restrict the use of described areas within the area over which he has jurisdiction. An order may close an area to entry or may restrict the use of an area by applying any or all of the prohibitions authorized in this subpart or any portion thereof.

(b) ....

Note: By authority of this regulation several California statutes have been adopted as Federal Regulations on National Forest land. See page B–5.

Section 261.52

Fire. When provided by an order, the following are prohibited:

(a) Building, maintaining, attending or using a fire, campfire, or stove fire.
(b) Using an explosive.
(c) Smoking.
(d) Smoking, except inside a building or vehicle, or while seated in an area at least three feet in diameter that is barren or cleared of all flammable materials.
(e) Going into or being upon an area.
(f) Possessing, discharging or using any kind of firework or other pyrotechnic device.
(g) Entering an area without any firefighting tool prescribed by the order.
(h) Operating an internal combustion engine except on a road.
(i) Welding, or operating an acetylene or other torch with open flame.
(j) Operating or using any internal or external combustion engine on any timber, brush, or grass covered land, including trails traversing such land, without a spark arrester, maintained in effective working order, meeting either (1) Department of Agriculture, Forest Service Standard 5100–la; or (2) the 80 percent efficiency level determined according to the appropriate Society of Automotive Engineers (SAE) recommended Practices J335 and J350.
(k) Violating any state law specified in the order concerning burning, fires or which is for the purpose of preventing, or restricting the spread of fires.

Order No. 77–2

Fire Restrictions – California Region

Pursuant to 36 CFR 261.50(a) and (b), each of the following is prohibited on or near any area, or forest development road or trail under my jurisdiction:

(1) Operating or using any internal or external combustion engine on any timber, brush, or grass covered land, including trails traversing such land, without a spark arrester maintained in effective working order meeting either (i) Department of Agriculture, Forest Service Standard 5100–la; or (ii) the appropriate Society of Automotive Engineers (SAE) Recommended Practices. 36 CFR 261.52(j).
Motor trucks, truck tractors, buses and passenger vehicles, except motorcycles, are not subject to the provisions of this section if the exhaust system is equipped with a muffler as defined in the California Vehicle Code.
(2) Possessing, discharging or using any kind of firework or other pyrotechnic device. 36 CFR 261.52(f).
(3) Violating any of the following California State Fire Laws. 36 CFR 261.52(k).

Public Resources Code:

Section 4291 – Reduction of Fire Hazards Around Buildings
4292 – Powerline Hazard Reduction
4293 – Powerline Clearance Required
4372 – Rubbish Dump Permits Required
4374 – Minimum Requirements for Rubbish Dumps
4423 – Written Permit Required for Burning
4427 – Clearing and Tools Required
4428 – Firefighting Tools Required on Industrial Operations; Power Equipment and Log Landings
4431 – Gasoline Power Saw – Clearance and Equipment Required
4446 – Incinerator Standards

Health and Safety Code:

12101 – Explosive Permit Required

(4) Smoking, except within enclosed vehicles, developed recreation sites, or while stopped in an area at least three feet in diameter that is barren or cleared of all flammable materials. 36 CFR 261.52(d).
(5) Building, maintaining, attending, or using a campfire without a permit in any area outside a developed recreation site from May 15 through October 31 of each year. 36 CFR 261.52(a).
(6) Welding, or operating an acetylene or other torch with open flame without a permit from May 15 through October 31 of each year. 36 CFR 261.52(i).

These prohibitions are in addition to the General Prohibitions in 36 CFR Part 261. This order may be made more restrictive by temporary orders issued by the Regional Forester, a Forest Supervisor, or the Administrator of the Lake Tahoe Basin Management Unit during periods of fire danger.

Pursuant to 36 CFR 261.50(e), each of the following persons is exempt from this order:

Persons with a permit.

Done at San Francisco, California, this 30th day of March, 1977.

/s/ Robert W. Cermak

Robert W. Cermak
Deputy Regional Forester
California Region

Violation of these prohibitions is punishable by a fine of not more than $500.00 or imprisonment for not more than six months or both.

See 16 U.S.C. 551.

Note: Forest Supervisors may also issue additional and/or more restrictive orders.

B. OPERATIONAL SAFETY

TITLE 49 CODE OF FEDERAL REGULATIONS (49CFR)

Section 213.37

Vegetation. Vegetation on railroad property which is on or immediately adjacent to roadbed must be controlled so that it does not—

(a) Become a fire hazard to track-carrying structures;
(b) Obstruct visibility of railroad signs and signals;
(c) Interfere with railroad employees performing normal trackside duties;
(d) Prevent proper functioning of signal and communication lines; or
(e) Prevent railroad employees from visually inspecting moving equipment from their normal duty stations.

Section 218.37

Flag protection.

(a) After August 1, 1977, each railroad must have in effect an operating rule which complies with the requirements set forth below:
  (1) Except as provided in subparagraph (2) of this paragraph, flag protection shall be provided—
    (i) When a train is moving on the main track at less than one-half the maximum authorized speed (including slow order limits) in that territory, flag protection against following trains on the same track must be provided by a crew member by dropping off single lighted fusees at intervals that do not exceed the burning time of the fusee.
    (ii) ....

(b) ....

(c) Whenever the use of fusees is prohibited by a Federal, State or local fire regulation, each railroad operating within that jurisdiction shall provide alternate operating procedures to assure full protection of trains in lieu of flag protection required by this section.

Section 230.203

Trip or daily inspection.

(a) Each locomotive unit when used in road service (including beltline, transfer or work-train service) shall be inspected at least once every 24 hours, except locomotive units operated on through runs exceeding 24 hours, may be inspected at the next crew change point immediately beyond the point at which the 24-hour period expires. ....

(b) ....

Section 230.204

General precautions.

(a) It must be known before each trip that the brakes are in safe and suitable condition for service; that the air compressor or compressors are in condition to provide an ample supply of air for the service in which the locomotive is put; that the devices for regulating all pressures are properly performing their functions; that the brake valves work properly in all positions; and that the water has been drained from the air-brake system.

(b) ....

Section 232.10

General rules; locomotives.

(a) Air brake and hand brake equipment on locomotives including tender must be inspected and maintained in accordance with the requirements of the Locomotive Inspection and United States Safety Appliance Acts and related orders and regulations of the Federal Railroad Administrator (FRA).

(b) It must be known that air brake equipment on locomotives is in a safe and suitable condition for service.

(c) ....

(h) ....

(i) (1) Foundation brake rigging, and safety supports, where used, must be maintained in a safe and suitable condition for service. Levers, rods, brake beams, hangars and pins must be of ample strength and must not bind or foul in any way that will affect proper operation of brakes. All pins must be properly applied and secured in place with suitable locking devices. Brake shoes must be properly applied and kept approximately in line with treads of wheels or other braking surfaces.

(2) ....

(k) ....

(l) Enginemen when taking charge of locomotives must know that the brakes are in operative condition.

(m) ....

Section 232.11

Train air brake system tests.

(a) Supervisors are jointly responsible with inspectors, enginemen and trainmen for condition of air brake and air signal equipment on motive power and cars to the extent that it is possible to detect defective equipment by required air tests.

(b) Communicating signal system on passenger equipment trains must be tested and known to be in a suitable condition for service before leaving terminal.

(c) Each train must have the air brakes in effective operating condition, and at no time shall the number and location of operative air brakes be less than permitted by Federal requirements. When piston travel is in excess of 10 inches, the air brakes cannot be considered in effective operating condition.

(d) Condensation must be blown from the pipe from which air is taken before connecting yard line or motive power to train.

Section 232.12

Initial terminal road train air–brake tests.

(a) Except for run–through and unit run–through trains covered under Section 232.19, each train must be inspected and tested as specified in this section at points—

(1) Where the train is originally made up (initial terminal);

(2) Where train consist is changed, other than by adding or removing a solid block of cars, and the train brake system remains charged; and

(3) Where the train is received in interchange.

(b) Each carrier shall designate additional inspection points not more than 500 miles apart where intermediate inspection will be made to determine that—

(1) Brake pipe pressure leakage does not exceed 5 pounds per minute;

(2) Brakes apply on each car in response to a 20–pound service brake pipe pressure reduction; and

(3) Brake rigging is properly secured and does not bind or foul.

(c) Train airbrake system must be charged to required air pressure, angle cocks and cutout cocks must be properly positioned, air hose must be properly coupled and must be in condition for service. An examination must be made for leaks and necessary repairs made to reduce leakage to a minimum. Retaining valves and retaining valve pipes must be inspected and known to be in condition for service. If train is to be operated in electro–pneumatic brake operation, brake circuit cables must be properly connected.

(d) (1) After the airbrake system on a freight train is charged to within 15 pounds of the setting of the feed valve on the locomotive, but to not less than 60 pounds, as indicated by an accurate gauge at rear end of train, and on a passenger train when charged to not less than 70 pounds, and upon receiving the signal to apply brakes for test, a 15–pound brake pipe service reduction must be made in automatic brake operations, the brake valve lapped, and the number of pounds of brake pipe leakage per minute noted as indicated by brake pipe gauge, after which brake pipe reduction must be increased to full service. Inspection of the train brakes must be made to determine that angle cocks are properly positioned, that the brakes are applied on each car, that piston travel is correct, that brake rigging does not bind or foul, and that all parts of the brake equipment are properly secured. When this inspection has been completed, the release signal must be given and brakes released and each brake inspected to see that all have released.

(2) ....

(3) ....

(e) Brake pipe leakage must not exceed 5 pounds per minute.

(f) (1) At initial terminal piston travel of body–mounted brake cylinders which is less than 7 inches or more than 9 inches must be adjusted to nominally 7 inches.

(2) ....

Section 232.13

Road train and intermediate terminal train air brake tests.

(a) Passenger trains: Before motive power is detached or angle cocks are closed on a passenger train operated in either automatic or electro–pneumatic brake operation, except when closing angle cocks for cutting off one or more cars from the rear end of train, automatic air brake must be applied. After recoupling, brake system must be recharged to required air pressure and before proceeding and upon receipt of proper request or signal, application and release tests of brakes on rear car must be made from locomotive in automatic brake operation. If train is to be operated in electro–pneumatic brake operation, this test must also be made in electro–pneumatic brake operation before proceeding. Inspector or trainman must determine if brakes on rear car of train properly apply and release.

(b) Freight trains: Before motive power is detached or angle cocks are closed on a freight train, brakes must be applied with not less than a 20 pound brake pipe reduction. After recoupling and angle cocks are opened, it must be known that brake pipe air pressure is being properly restored as indicated by the caboose gauge and that brakes on rear car are released. In the absence of a caboose gauge, air brake test must be made as prescribed by that portion of paragraph (a) of this section pertaining to automatic brake operation.

(c) (1) At a point other than initial terminal where locomotive or caboose is changed, or where one or more consecutive cars are cut off from rear end or head end of train with consist otherwise remaining intact, after train brake system is charged to within 15 pounds of feed valve setting on locomotive but not less than 60 pounds as indicated at rear of freight train, and on a passenger train to at least 70 pounds, a 20 pound brake pipe reduction must be made and it must be determined that brakes on rear car apply and release properly.

(2) Before proceeding it must be known that brake pipe pressure as indicated at rear of freight train is being restored.

(3) ....

(d) (1) At a point other than a terminal where one or more cars are added to a train, and after the train brake system is charged to not less than 60 pounds as indicated by a gauge at the rear of freight train and on a passenger train to not less than 70 pounds, tests of air brakes must be made to determine that brake pipe leakage does not exceed five (5) pounds per minute as indicated in the brake pipe gauge after a 15–pound brake pipe reduction. After the leakage test is completed, brake pipe reduction must be increased to full service, and it must be known that the brakes on each of these cars and on the rear car of train apply and release. Cars added to train which have not been inspected in accordance with Section 232.12 (c)–(j) must be so inspected and tested at next terminal where facilities are avilable for such attention.

(2) (i) ....

Section 232.19

Air brake tests on run–through and unit run–through trains.

(b) ....

(c) Each run–through train shall be inspected and tested as prescribed by Section 232.12 (c)–(j)—

(1) Where the train is originally made up (initial terminal);

(2) Where train consist is changed other than by adding or removing a solid block of cars and train brake system remains charged; and

(3) At intermediate inspection points not more than 500 miles apart, subject to the requirements of paragraph (f) of this section.

(d) ....

(g) ....

(h) Each carrier shall record the inspections and tests made under Section 232.12 (c)–(j) as required by this section at the time they are performed by completing Form FRA F–6180–48 in duplicate. This form shall be signed by the supervisor or other carrier employee responsible for the inspections and tests. One copy of the form shall be kept in the cab of the locomotive until the train arrives at its final terminal, and one copy shall be retained for 3 months at the terminal where the inspections and tests are made.

(i) At locations where the crew of one carrier takes over control and operation of a run–through train or unit run–through train from the crew of another carrier, the receiving carrier shall inspect and test the train to determine that—

(1) The cab of the locomotive contains a Form FRA F–6180–48 completed as required by paragraph (h) of this section;

(2) Brake pipe leakage does not exceed 5 pounds per minute; and

(3) Brakes apply and release on the rear car from a 20–pound service brake pipe pressure reduction.

If the cab of the locomotive does not contain a completed Form FRA F–6180–48, the train must be inspected and tested as prescribed by Section 232.12 (c)–(j) before it proceeds.

II. STATE LAWS

HEALTH AND SAFETY CODE (H&SC)

Section 13000

Responsibility in Control of Fire. Every person is guilty of a misdemeanor who allows a fire kindled or attended by him to escape from his control or to spread to the lands of any person other than the builder of the fire without using every reasonable and proper precaution to prevent the fire from escaping.

Section 13001

Causing Fire, Misdemeanor. Every person is guilty of a misdemeanor who, through careless or negligent action, throws or places any lighted cigarette, cigar, ashes, or other flaming or glowing substance, or any substance or thing which may cause a fire, in any place where it may directly or indirectly start a fire, or who uses or operates a welding torch, tar pot or any other device which may cause a fire, who does not clear the inflammable material surrounding the operation or take such other reasonable precautions necessary to insure against the starting and spreading of fire.

Section 13002

Throwing from vehicle substance which may cause fire; private owners; punishment.

(a) Every person is guilty of a misdemeanor who throws or discharges any lighted or nonlighted cigarette, cigar, match, or any flaming or glowing substances, or any substance or thing which may cause a fire upon any highway, including any portion of the right–of–way thereof, sidewalk or upon any public or private property. No portion of this subdivision shall be construed to restrict a private owner in the use of his own private property, except that the placing, depositing, or dumping of such waste matter on such property shall not create a public health and safety hazard, a public nuisance, or a fire hazard, as determined by a local health department, local fire department or fire district, or the Division of Forestry in which case the provisions of this section shall apply.

(b) Every person convicted of a violation of this section shall be punished by a mandatory fine of not less than ten dollars ($10) nor more than five hundred dollars ($500) upon a first conviction, by a mandatory fine of not less than twenty–five dollars ($25) nor more than five hundred dollars ($500) upon a second conviction, and by a mandatory fine of not less than fifty dollars ($50) nor more than five hundred dollars ($500) upon a third or subsequent conviction.

The court may, in addition to the fine imposed upon a second or subsequent conviction, require as a condition of probation, in addition to any other condition, that any person convicted of a violation of this section pick up litter at a time and place within the jurisdiction of the court for not less than four hours upon a second conviction and for not less than eight hours upon a third or subsequent conviction.

Section 13003

Spark arresters required on steam powered equipment. Every person is guilty of a misdemeanor who uses any steam–powered logging locomotive, donkey, or threshing engine, or any other steam engine or steam boiler, in or near any forest, brush, grass, grain, or stubble land, unless the steam engine or steam boiler is provided with adequate devices to prevent the escape of fire or sparks and unless he uses every reasonable precaution to prevent the causing of fire thereby.

Section 13007

Liability for Damage. Any person who personally or through another willfully, negligently, or in violation of law, sets fire to, allows fire to be set to, or allows a fire kindled or attended by him to escape to, the property of another, whether privately or publicly owned, is liable to the owner of such property for any damages to the property caused by the fire.

Section 13008

Due Diligence Required. Any person who allows any fire burning upon his property to escape to the property of another, whether privately or publicly owned, without exercising due diligence to control such fire, is liable to the owner of such property for the damages to the property caused by the fire.

Section 13009

Suppression Cost Collectible. Any person who negligently, or in violation of the law, sets a fire, allows a fire to be set, or allows a fire kindled or attended by him to escape onto any forest, range or nonresidential grass–covered land is liable for the expense of fighting the fire and such expense shall be a charge against that person. Such charge shall constitute a debt of such person, and is collectible by the person, or by the federal, state, county, public, or private agency, incurring such expenses in the same manner as in the case of an obligation under a contract, expressed or implied.

PUBLIC RESOURCES CODE (PRC)

Section 4021.

Penalty. Except as otherwise provided, the willful or negligent commission of any of the acts prohibited or the omission of any of the acts required by Chapter 2 (commencing with Section 4251) to Chapter 6 (commencing with Section 4411), inclusive, of Part 2 of this division is a misdemeanor.

Section 4101

"Person" Defined. "Person" includes any agency of the state, county, city, district, or other local public agency, and any individual, firm, association, partnership, business trust, corporation or company.

Section 4103

"Forest Fire" Defined. "Forest fire" means a fire burning uncontrolled on lands covered wholly or in part by timber, brush, grass, grain, or other flammable vegetation.

Section 4104

"Uncontrolled Fire" Defined. The term "uncontrolled fire," as used in this division, means any fire which threatens to destroy life, property, or resources and either: (1) is not burning within the confines of cleared firebreaks; or (2) is burning with such velocity that it could not be readily extinguished with the ordinary tools commonly available to private property.

Section 4117

Local Ordinances. Any county, city, or district may adopt ordinances, rules, or regulations to provide fire prevention restrictions or regulations that are necessary to meet local conditions of weather, vegetation, or other fire hazards. Such ordinances, rules, or regulations may be more restrictive than state statutes in order to meet local fire hazard conditions.

Section 4118

Burning of Vegetation, Public Purpose. The burning of growing, dead, or downed vegetation is for a public purpose if the department has determined that the burning of such vegetation is necessary for the prevention or suppression of forest fires.

Section 4119

Enforcement of State Forest and Fire Laws. The department, or its duly authorized agent, shall enforce the state forest and fire laws. The department may inspect all properties, except the interior of dwellings, subject to the state forest and fire laws, for the purpose of ascertaining compliance with such laws.

Note: By interagency agreement, many employees of the U.S. Forest Service, Bureau of Land Management, National Park Service and certain county fire departments are "duly authorized agents" of the Department of Forestry.

Section 4170

Uncontrolled Fire is Public Nuisance. Any uncontrolled fire burning on any lands covered wholly or in part by timber, brush, grass, grain or any other flammable material, without proper precaution being taken to prevent its spread notwithstanding the origin of such fire, is a public nuisance by reason of its menace to life and property.

Section 4171

Public Nuisances—Defined. Any condition endangering public safety by creating a fire hazard and which exists upon any property which is included within any state responsibility area is a public nuisance.

Section 4172

Abatement of Nuisance, Notice. Whenever the director determines that a public nuisance, as defined in Section 4171, exists, he shall notify the owner of the property to abate the public nuisance. If the owner is unknown, a copy of the notice shall be posted upon the property.

Section 4291

Firebreaks; Trimming of Trees; Chimney Screens; Variance or Exemption by Regulations of State Forester. Any person that owns, leases, controls, operates, or maintains any building or structure in, upon, or adjoining any mountainous area or forest–covered lands, brush–covered lands, or grass–covered lands, or any land which is covered with flammable material, shall at all times do all of the following:

(a) Maintain around and adjacent to such building or structure a firebreak made by removing and clearing away, for a distance of not less than 30 feet on each side thereof or to the property line, whichever is nearer, all flammable vegetation or other combustible growth. This subdivision does not apply to single specimens of trees, ornamental shrubbery, or similar plants which are used as ground cover, if they do not form a means of rapidly transmitting fire from the native growth to any building or structure.

(b) Maintain around and adjacent to any such building or structure additional fire protection or firebreak made by removing all brush, flammable vegetation, or combustible growth which is located from 30 feet to 100 feet from such building or structure or to the property line, whichever is nearer, as may be required by the director if he finds that, because of extra hazardous conditions, a firebreak of only 30 feet around such building or structure is not sufficient to provide reasonable fire safety. Grass and other vegetation located more than 30 feet from such building or structure and less than 18 inches in height above the ground may be maintained where necessary to stabilize the soil and prevent erosion.

(c) Remove that portion of any tree which extends within 10 feet of the outlet of any chimney or stovepipe.

(d) Maintain any tree adjacent to or overhanging any building free of dead or dying wood.

(e) Maintain the roof of any structure free of leaves, needles, or other dead vegetative growth.

(f) Provide and maintain at all times a screen over the outlet of every chimney or stovepipe that is attached to any fireplace, stove, or other device that burns any solid or liquid fuel. The screen shall be constructed of nonflammable material with openings of not more than one–half inch in size.

(g) The director may adopt regulations exempting structures with exteriors constructed entirely of nonflammable materials, or conditioned upon the contents and composition of same, he may vary the requirements respecting the removing or clearing away of flammable vegetation or other combustible growth with respect to the area surrounding said structures.

No such exemption or variance shall apply unless and until the occupant thereof, or if there be no occupant, then the owner thereof, files with the department, in such form as the director shall prescribe, a written consent to the inspection of the interior and contents of such structure to ascertain whether the provisions hereof and the regulations adopted hereunder are complied with at all times.

Note: Wooden culverts, trestles, bridges and snowsheds are considered as structures insofar as this code section is concerned.

Section 4413

"Zone A" includes any county and any portion of any county which is south of the Mount Diablo baseline, except the Counties and the portions of the Counties of Alameda, Calaveras, Contra Costa, Marin, Mariposa, Mono, San Francisco, San Joaquin, Stanislaus, and Tuolumne which are south of such line.

Section 4414

"Zone B" includes any county and portion of any county which is not included in Zone A.

Section 4422

Allowing Fire to Escape. A person shall not do any of the following:

(a) Willfully or knowingly allow fire to burn uncontrolled on land which he owns or controls, or to escape to the lands of any person other than that of the owner.

(b) Allow any fire kindled or attended by him to escape from his control or to spread to the land of any person other than from the land from which the fire originated.

Section 4423

Burning Permits, Zones, Times. A person shall not burn any brush, stumps, logs, fallen timber, fallows, slash, grass–covered land, brush–covered land, forest–covered land, or other flammable material, in any state responsibility area, area receiving fire protection by the department by contract, or upon federal lands administered by the United States Department of Agriculture or Department of the Interior, unless he has a written permit from the department or its duly authorized representative or the authorized federal officer on federal lands administered by the United States Departments of Agriculture or Interior and in strict accordance with the terms of the permit:

(a) At any time in Zone A.

(b) At any time in Zone B between April 1st and December 1st of any year, or at any other time in Zone B during any year when the director has declared, by proclamation, that unusual fire hazard conditions exist in the area.

Note: See Sections 4413 and 4414 above.

Section 4425

Violations of Permit, Effect. Any violation of the terms of a burning permit issued pursuant to Section 4423, a restricted temporary burning permit issued pursuant to Section 4423.2, or a campfire permit issued pursuant to Section 4433 renders the permit null and void.

Section 4427

Clearing and Tools Required. During any time of the year when burning permits are required in an area pursuant to this article, no person shall use or operate any motor, engine, boiler, stationary equipment, welding equipment, cutting torches, tarpots, or grinding devices from which a spark, fire, or flame may originate, which is located on or near any forest–covered land, brush–covered land, or grass–covered land, without doing both of the following:

(a) First clearing away all flammable material, including snags, from the area around such operation for a distance of 10 feet.

(b) Maintain one serviceable round point shovel with an overall length of not less than forty–six (46) inches and one backpack pump watertype fire extinguisher fully equipped and ready for use at the immediate area during the operation.

This section does not apply to portable powersaws and other portable tools powered by a gasoline–fueled internal combustion engine. (See Sec. 4431 re powersaws)

Section 4428

Fire Fighting Tools Required on Industrial Operations; Power Equipment and Log Landings. No person, except any member of an emergency crew or except the driver or owner of any service vehicle owned or operated by or for, or operated under contract with, a publicly or privately owned utility, which is used in the construction, operation, removal, or repair of the property or facilities of such utility when engaged in emergency operations, shall use or operate any vehicle, machine, tool or equipment powered by an internal combustion engine operated on hydrocarbon fuels, in any industrial operation located on or near any forest, brush, or grass–covered land between April 1 and December 1 of any year, or at any other time when ground litter and vegetation will sustain combustion permitting the spread of fire, without providing and maintaining, for firefighting purposes only, suitable and serviceable tools in the amounts, manner and location prescribed in this section.

(a) On any such operation a sealed box of tools shall be located, within the operating area, at a point accessible in the event of fire. This fire toolbox shall contain: one backpack pump–type fire extinguisher filled with water, two axes, two McLeod fire tools, and a sufficient number of shovels so that each employee at the operation can be equipped to fight fire.

(b) One or more serviceable chainsaws of three and one–half or more horsepower with a cutting bar 20 inches in length or longer shall be immediately available within the operating area or, in the alternative, a full set of timber–felling tools shall be located in the fire tool box, including one crosscut falling saw six feet in length, one double–bit ax with a 36–inch handle, one sledge hammer or maul with a head weight of six, or more, pounds and handle length of 32 inches, or more, and not less than two falling wedges.

(c) Each rail speeder and passenger vehicle, used on such operation shall be equipped with one shovel and one ax, and any other vehicle used on the operation shall be equipped with one shovel. Each tractor used in such operation shall be equipped with one shovel.

(d) As used in this section:

  (1) "Vehicle" means a device by which any person or property may be propelled, moved, or drawn over any land surface, excepting a device moved by human power or used exclusively upon stationary rails or tracks.
  (2) "Passenger vehicle" means a vehicle which is self–propelled and which is designed for carrying not more than 10 persons including the driver, and which is used or maintained for the transportation of persons, but does not include any motortruck or truck tractor.

Note: Railroad operations are considered to be industrial operations insofar as this code section is concerned.

Section 4432

Neglecting Campfire. A person shall not leave a campfire, kindled or attended by him, burning or unextinguished unless one of the following requirements is satisfied:

(a) He leave some person in attendance.

(b) The fire is enclosed within a stove, oven, drum, or other nonflammable container, in such manner that the fire cannot escape from the container.

(c) The fire is within a permanent dwelling regularly and permanently inhabited by human beings at that time. No person shall allow a campfire, kindled or atteded by him, to spread after it is built.

Note: A campfire is: A fire used by one or more persons while camping, picnicking, recreating, or working on grass, brush, or forest–covered land, to provide any one or a combination of the following: heat for cooking, heat for personal warmth, light for ceremonial, esthetic or other purposes. Campfires include open fires, those contained within fire places or enclosed stoves with flues or chimneys, stoves using pressurized liquid or gaseous fuels, portable braziers or space–heating devices which are used outside of any building, trailer, house, or living accommodation mounted on a motor vehicle.

Liability: A campfire builder will be held liable for the cost of suppression and damages caused by any wildfire that starts through negligence on his part.

Section 4433

Same: Permits Required. A person shall not light, maintain, or use a campfire upon any brush–covered land, grass–covered land, or forest–covered land which is the property of another person unless he first obtains a written permit from the owner, lessee, or agent of the owner or lessee of the property.

If, however, campsites and special areas have been established by the property owner and posted as areas for camping, a permit is not necessary. A written campfire permit duly issued by or under the authority of the United States Forest Service is necessary for use on land under the jurisdiction and control of the United States Forest Service.

Section 4434

Campfire Escape. The escape of any campfire from the control of any person who is maintaining the campfire is prima facie evidence that such person was negligent in maintaining the campfire.

Section 4435

Origination of Fire—Negligence. If any fire originates from the operation or use of any engine, machine, barbecue, incinerator, railroad rolling stock, chimney, or any other device which may kindle a fire, the occurrence of the fire is prima facie evidence of negligence in the maintenance, operation, or use of such engine, machine, barbecue, incinerator, railroad rolling stock, chimney or other device. If such fire escapes from the place where it originated and it can be determined which person's negligence caused such fire, such person is guilty of a misdemeanor.

Section 4442

Using Equipment Without Spark Arrester. Except as otherwise provided in this section, a person shall not use or operate any internal combustion engine which is operated on hydrocarbon fuels on any forest–covered land, brush–covered land, or grass–covered lands without providing, and maintaining in effective working order, a spark arrester attached to the exhaust system. For the purposes of this section, a spark arrester is a device constructed of nonflammable materials specifically for the purpose of removing and retaining carbon and other flammable particles over 0.0232 of an inch in size from the exhaust flow of an internal combustion engine that is operated by hydrocarbon fuels. Motor trucks, truck tractors, buses and passenger vehicles, except motorcycles, are not subject to the provisions of this section if the exhaust system is equipped with a muffler as defined in the Vehicle Code.

Spark arresters affixed to the exhaust system of engines or vehicles, as described in this section, shall not be placed or mounted in such a manner as to allow flames or heat from the exhaust system to ignite any flammable material.

III. STATE REGULATIONS

PUBLIC UTILITIES COMMISSION (PUC)

General Order 118 (GO118)

It is ordered by the Public Utilities Commission of the State of California that each railroad corporation operating in the State of California shall file its standards for the construction, reconstruction and for the subsequent maintenance of walkways adjacent to its tracks as hereinafter required....

IV. LOCAL ORDINANCES

It is not uncommon for counties, cities and special districts to have fire ordinances that affect railroad operations. They are too numerous and varied to allow their listing here. It is therefore important for railroad and protection agency employees alike to learn the provisions of these ordinances and to comply with them.

V. PRIVATE REGULATIONS

A. Association of American Railroad (AAR)

The AAR publishes a 446 page "Field Manual of the AAR Interchange Rules" and an "Office Manual." These are too lengthy to be reproduced here and most of them have little or no bearing on fire prevention. However, some of these rules, particularly those relating to air brakes and brake equipment relate indirectly to fire prevention. Regulatory as well as operating personnel should be familiar with these rules.

B. Company Rules

Both the FRA and the PUC implement many of their orders and regulations by requiring each operating company to establish and enforce company rules in certain fields. In addition each company has many rules of its own. These are to be found in various rule books and time tables. Few of them relate directly to fire prevention but a good many relate indirectly.

VI. PERMITS AND EASEMENTS

Most railroad operations are conducted on deeded rights–of–way. Some of these were obtained by land grant and others by purchase. There are, however, significant lengths of railroad right–of–way that are not deeded but which are occupied pursuant to some sort of easement or special use permit with title to the land remaining in someone else's hands. The title holder is most often, but not always, some branch of government.

These permits and easements almost always contain conditions and stipulations many of which relate to fire prevention. Often they have been in effect so long that they have been forgotten. It is important to review them periodically.

Appendix C

LOCAL DIRECTORY

I. RAILROAD COMPANIES

A. Name

Notification Address

Phones: Business Emergency

Company Officer (Gen. Mgr., Div. Supt., etc.)

Maintenance–of–Way Superv. (Div. Eng., etc.)

Operations Superv. (Div. Trainmaster, etc.)

Mechanical Superv. (Supt. Locomotives, etc.)

B. Name

Notification Address

Phones: Business Emergency

Company Officer (Gen. Mgr., Div. Supt., etc.)

Maintenance–of–Way Superv. (Div. Eng., etc.)

Operations Superv. (Div. Trainmaster, etc.)

Mechanical Superv. (Supt. Locomotives, etc.)

C. Name

Notification Address

Phones: Business Emergency

Company Officer (Gen. Mgr., Div. Supt., etc.)

Maintenance–of–Way Superv. (Div. Eng., etc.)

Operations Superv. (Div. Trainmaster, etc.)

Mechanical Superv. (Supt. Locomotives, etc.)

II. PROTECTION AGENCIES

A. Name Unit

Address

Phones: Business Emergency

Administrator Title

Fire Officer Title

Fire Prevention Officer Title

B. Name Unit

Address

Phones: Business Emergency

Administrator Title

Fire Officer Title

Fire Prevention Officer Title

C. Name Unit

Address

Phones: Business Emergency

Administrator Title

Fire Officer Title

Fire Prevention Officer Title

III. SPECIAL NOTES

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